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Theory of Porous Media
Multiphase Flow
Multiphase flow through porous media, with special reference to the turbulent region

NICKOLAS ANGIE

Fluids in Porous Media Morgan & Claypool Publishers
In the hydrocarbon reservoirs that are normally saturated with two or more fluids, in order for better description of the flowing fluids behaviors and rock-fluid interaction, the concept of relative permeability and capillary pressure should be exploited. Brilliant by Petrell AS is an object-oriented (C++) multi-physics Computational Fluid Dynamics (CFD) package developed for simulation of flow. In the continuous process of improving the system, the aim of this work is to model the multiphase flow through porous media using Darcy's equation. The models in the developed code are based on the conservation equation for each mass to obtain the pressure and saturation fields. After the code is benchmarked against the results from Eclipse for the simulation of single-phase flow, another phase is added to the porous flow part of the code to perform the simulation of multiphase flow through porous media. In this process, first the transmissibilities in the already implemented FVM code have been corrected. Then capillary pressure equations and different relative permeability models have been added to the code.
Computational Methods in Multiphase Flow VIII SIAM
This book presents the latest research in one of the most challenging, yet most universally applicable areas of technology. Multiphase flows are found in all areas of technology, at all length scales and flow regimes, involving compressible or incompressible linear or nonlinear fluids. The range of related problems of interest is vast, including astrophysics, biology, geophysics, atmospheric process, and many areas of engineering. The solution of the equations that describe such complex problems often requires a combination of advanced computational and experimental methods. For example, any models developed must be validated through the application of expensive and difficult experimental techniques. Numerous problems in the area thus remain as yet unsolved, including modelling nonlinear fluids, modelling and tracking interfaces, dealing with multiple length scales, characterising phase structures, and treating drop break-up and coalescence. The papers contained in the book were presented at the eighth in a well established series of biennial conferences that began in 2001. They represent close interaction between numerical modellers and other researchers working to gradually resolve the many outstanding issues in understanding of multiphase flow. The papers in the book cover such topics as: Multiphase Flow Simulation; Bubble and Drop Dynamics; Interface Behaviour; Experimental Measurements; Energy Applications; Compressible Flows; Flow in Porous Media; Turbulent Flow; Image Processing; Heat Transfer; Atomization; Hydromagnetics; Plasma; Fluidised Beds; Cavitation.
Multiphase Lattice Boltzmann Methods Elsevier
Multiphase flows are found in all areas of technology, at all length scales and flow regimes and can involve compressible or incompressible linear or nonlinear, fluids.

However, although they are ubiquitous, multiphase flows continue to be one of the most challenging areas of computational mechanics, with numerous problems as yet unsolved. Advanced computational and experimental methods are often required to solve the equations that describe such complex problems. The many challenges that must be faced in solving them include modelling nonlinear fluids, modelling and tracking interfaces, dealing with multiple length scales, characterising phase structures, and treating drop break-up and coalescence. It is important to validate models, which calls for the use of expensive and difficult experimental techniques.This book presents contributions on the latest research in the techniques for solving multiphase flow problems, presented at the seventh in a biennial series of conferences on the subject that began in 2001. Featured topics include: Flow in porous media; Turbulent flow; Multiphase flow simulation; Image processing; Heat transfer; Atomization; Interface behaviour; Oil and gas applications; Experimental measurements; Energy applications; Biological flows; Micro and macro fluids; Compressible flows.

Multiphase Flow in Porous Media LAP Lambert Academic Publishing

This book provides a fundamental description of multiphase fluid flow through porous rock, based on understanding movement at the pore, or microscopic, scale.

Multiphase Chemical Transport in Porous Media Springer Science & Business Media

CLIFFORD K. HOAND STEPHEN W. WEBB Sandia National Laboratories, P. O. Box 5800, Albuquerque, NM 87185, USA Gas and vapor transport in porous media occur in a number of important applications includingdryingofindustrialandfoodproducts,oilandgasexploration,environm- tal remediation of contaminated sites, and carbon sequestration. Understanding the fundamental mechanisms and processes of gas and vapor transport in porous media allows models to be used to evaluate and optimize the performance and design of these systems. In this book, gas and vapor are distinguished by their available states at stan- ? dard temperature and pressure (20 C, 101 kPa). If the gas-phase constituent can also exist as a liquid phase at standard temperature and pressure (e. g. , water, ethanol, toluene, trichlorothylene), it is considered a vapor. If the gas-phase constituent is non-condensable at standard temperature and pressure (e. g. , oxygen, carbon di- ide, helium, hydrogen, propane), it is considered a gas. The distinction is important because different processes affect the transport and behavior of gases and vapors in porous media. For example, mechanisms specific to vapors include vapor-pressure lowering and enhanced vapor diffusion, which are caused by the presence of a g-phase constituent interacting with its liquid phase in an unsaturated porous media. In addition, the “heat-pipe” exploits isothermal latent heat exchange during evaporation and condensation to effectively transfer heat in designed and natural systems.

Multiphase Flow in Porous Media at Low Interfacial Tension MDPI

Non-Invasive Monitoring of Multiphase Flows is a result of the latest advances realized in non-invasive measurement of multiphase systems by means of various tomographic and velocimetric techniques. Written by experts on special topics within the realm of this

subject, the book reviews in 15 chapters the theoretical background and the physics of the measurement process for each of a number of techniques. In addition, the mathematical modeling related to the measured property, such as in the image reconstitution problem for tomography, successful application of the techniques for measurement in various multiphase systems and their advantages and limitations are described. Features of this book: - Comprehensive and Complete. Covers both theoretical and application viewpoints of noninvasive measuring techniques in multiphase systems. There is no book available on this subject in the field of multiphase flows - Versatile. Material is presented in such a way that the book can be used either for research or for teaching graduate students specializing in the topic of multiphase flows - Awareness and Uniformity. The engineering community is made aware of advantages of these new techniques and they are presented in a uniform package. The editors strive to provide a comprehensive compendium of all the relevant information essential for practising engineers, consultants, university professors, graduate students and technicians who are involved in the study of multiphase flow phenomena. The book, although directed to the study of multiphase systems of interest to the chemical engineer, also provides valuable information for all other engineering disciplines that deal with multiphase systems.

An Introduction to Reservoir Simulation Using MATLAB/GNU Octave Springer Science & Business Media

"This book introduces the novel porous media formulation for multiphase flow conservation equations, a new, flexible, and unified approach to solve real-world engineering problems"--

Multiphase Flow in Permeable Media WIT Press

The Multiphase Flow Handbook, Second Edition is a thoroughly updated and reorganized revision of the late Clayton Crowe’s work, and provides a detailed look at the basic concepts and the wide range of applications in this important area of thermal/fluids engineering. Revised by the new editors, Efstathios E. (Stathis) Michaelides and John D. Schwarzkopf, the new Second Edition begins with two chapters covering fundamental concepts and methods that pertain to all the types and applications of multiphase flow. The remaining chapters cover the applications and engineering systems that are relevant to all the types of multiphase flow and heat transfer. The twenty-one chapters and several sections of the book include the basic science as well as the contemporary engineering and technological applications of multiphase flow in a comprehensive way that is easy to follow and be understood. The editors created a common set of nomenclature that is used throughout the book, allowing readers to easily compare fundamental theory with currently developing concepts and applications. With contributed chapters from sixty-two leading experts around the world, the Multiphase Flow Handbook, Second Edition is an essential reference for all researchers, academics and engineers working with complex thermal and fluid systems.

Multiphase Fluid Flow in Porous and Fractured Reservoirs Frontiers Media SA

This book provides concise, up-to-date and easy-to-follow information on certain aspects of an ever important research area: multiphase flow in porous media. This flow type is of great significance in

many petroleum and environmental engineering problems, such as in secondary and tertiary oil recovery, subsurface remediation and CO2 sequestration. This book contains a collection of selected papers (all refereed) from a number of well-known experts on multiphase flow. The papers describe both recent and state-of-the-art modeling and experimental techniques for study of multiphase flow phenomena in porous media. Specifically, the book analyses three advanced topics: upscaling, pore-scale modeling, and dynamic effects in multiphase flow in porous media. This will be an invaluable reference for the development of new theories and computer-based modeling techniques for solving realistic multiphase flow problems. Part of this book has already been published in a journal. Audience This book will be of interest to academics, researchers and consultants working in the area of flow in porous media.

MULTIPHASE FLOW OF IMMISCIBLE FLUIDS IN POROUS MEDIA. Springer

This book introduces the reader into the field of the physics of processes occurring in porous media. It targets Master and PhD students who need to gain fundamental understanding the impact of confinement on transport and phase change processes. The book gives brief overviews of topics like thermodynamics, capillarity and fluid mechanics in order to launch the reader smoothly into the realm of porous media. In-depth discussions are given of phase change phenomena in porous media, single phase flow, unsaturated flow and multiphase flow. In order to make the topics concrete the book contains numerous example calculations. Further, as much experimental data as possible is plugged in to give the reader the ability to quantify phenomena.

Computational Methods in Multiphase Flow IV Springer Science & Business Media

The need to predict, understand, and optimize complex physical and c- mical processes occurring in and around the earth, such as groundwater c- tamination, oil reservoir production, discovering new oil reserves, and ocean hydrodynamics, has been increasingly recognized. Despite their seemingly disparate natures, these geoscience problems have many common mathe- tical and computational characteristics. The techniques used to describe and study them are applicable across a broad range of areas. The study of the above problems through physical experiments, mat- matical theory, and computational techniques requires interdisciplinary col- boration between engineers, mathematicians, computational scientists, and other researchers working in industry, government laboratories, and univ- sities. By bringing together such researchers, meaningful progress can be made in predicting, understanding, and optimizing physical and chemical processes. The International Workshop on Fluid Flow and Transport in Porous - dia was successfully held in Beijing, China, August 2{6, 1999. The aim of this workshop was to bring together applied mathematicians, computational scientists, and engineers working actively in the mathematical and nume- cal treatment of ?uid ?ow and transport in porous media. A broad range of researchers presented papers and discussed both problems and current, state-of-the-art techniques.

Numerical Treatment of Multiphase Flows in Porous Media Cambridge

University Press
The fluid flow in fracture porous media plays a significant role in the assessment of deep underground reservoirs, such as through CO2 sequestration, enhanced oil recovery, and geothermal energy development. Many methods have been employed—from laboratory experimentation to theoretical analysis and numerical simulations—and allowed for many useful conclusions. This Special Issue aims to report on the current advances related to this topic. This collection of 58 papers represents a wide variety of topics, including on granite permeability investigation, grouting, coal mining, roadway, and concrete, to name but a few. We sincerely hope that the papers published in this Special Issue will be an invaluable resource for our readers.

Fractured Porous Media Cambridge University Press
This is a consistent treatment of the material-independent fundamental equations of the theory of porous media, formulating constitutive equations for frictional materials in the elastic and plastic range, while tracing the historical development of the theory. Thus, for the first time, a unique treatment of fluid-saturated porous solids is presented, including an explanation of the corresponding theory by way of its historical progression, and a thorough description of its current state.

Multiphase Flow Through Porous Media Elsevier
Fluid Dynamics is one of the most important topics of applied mathematics and physics. Together with complex flows and turbulence, multiphase flows remains one of the most challenging areas of computational mechanics, and even seemingly simple problems remain unsolved to date. Multiphase flows are found in all areas of technology, at all length scales and flow regimes. The fluids involved can be compressible or incompressible, linear or nonlinear. Because of the complexity of the problem, it is often essential to utilize advanced computational and experimental methods to solve the complex equations that describe them. Challenges in these simulations include nonlinear fluids, treating drop breakup and coalescence, characterizing phase structures, and many others.This volume brings together work presented at the Fourth International Conference on Computational and Experimental Methods in Multiphase and Complex Flows. Featured topics include: Suspensions; Bubble and Drop Dynamics; Flow in Porous Media; Interfaces; Turbulent Flow; Injectors and Nozzles; Particle Image Velocimetry; Macroscale Constitutive Models; Large Eddy Simulation; Finite Volumes; Interface Tracking Methods; Biological Flows; Environmental Multiphase Flow; Phase Changes and Stochastic Modelling.

Multiphase Flow in Porous Media Cambridge University Press
This book provides a systematic treatment of the geometrical and transport properties of fractures, fracture networks, and fractured porous media. It is divided into two major parts. The first part deals with geometry of individual fractures and of fracture networks. The use of the dimensionless density rationalizes the results for the percolation threshold of the networks. It presents the crucial advantage of grouping the numerical data for various fracture shapes. The second part deals mainly with permeability under steady conditions of fractures, fracture networks, and fractured porous media.

Again the results for various types of networks can be rationalized by means of the dimensionless density. A chapter is dedicated to two phase flow in fractured porous media.
Computational Methods for Multiphase Flows in Porous Media John Wiley & Sons
This book offers a fundamental and practical introduction to the use of computational methods. A thorough discussion of practical aspects of the subject is presented in a consistent manner, and the level of treatment is rigorous without being unnecessarily abstract. Each chapter ends with bibliographic information and exercises.
Gas Transport in Porous Media WIT Press
The selected papers contained in this book present the latest research in one of the most challenging, yet most universally applicable areas of technology. Multiphase flows are found in all areas of technology and the range of related problems of interest is vast, including many areas of science and engineering. Recently multiphase fluid dynamics have generated a great deal of attention, leading to many notable advances in experimental, analytical and numerical studies. It is perhaps, however, work on numerical solutions which is the most noticeable owing to the continuing improvements in computer software tools. Progress in numerical methods has permitted the solution of many practical problems, helping to improve our understanding of the physics involved. The presented papers illustrate the close interaction between numerical modellers and researchers working to gradually resolve the many outstanding issues in our understanding of multiphase flow.
Novel Porous Media Formulation for Multiphase Flow Conservation Equations WIT Press
This book introduces the reader into the field of the physics of processes occurring in porous media. It targets Master and PhD students who need to gain fundamental understanding the impact of confinement on transport and phase change processes. The book gives brief overviews of topics like thermodynamics, capillarity and fluid mechanics in order to launch the reader smoothly into the realm of porous media. In-depth discussions are given of phase change phenomena in porous media, single phase flow, unsaturated flow and multiphase flow. In order to make the topics concrete the book contains numerous example calculations. Further, as much experimental data as possible is plugged in to give the reader the ability to quantify phenomena.
Wetting and Spreading Effects on Multiphase-flow in Porous Media Butterworth-Heinemann
Fluid flow in transforming porous rocks, fracture networks, and granular media is a very active interdisciplinary research subject in Physics, Earth Sciences, and Engineering. Examples of natural and engineered processes include hydrocarbon recovery, carbon dioxide geo-sequestration, soil drying and wetting, pollution remediation, soil liquefaction, landslides, dynamics of wet or dry granular media, dynamics of faulting or friction, volcanic eruptions, gas venting in sediments, karst development and speleogenesis, ore deposit development, and radioactive waste disposal. Hydrodynamic flow instabilities and pore scale disorder typically result in complex flow patterning. In transforming media, additional mechanisms come into play: compaction, de-compaction, erosion,

segregation, and fracturing lead to changes in permeability over time. Dissolution, precipitation, and chemical reactions between solutes and solids may gradually alter the composition and structure of the solid matrix, either creating or destroying permeable paths for fluid flow. A complex, dynamic feedback thus arises where, on the one hand, the fluid flow affects the characteristics of the porous medium, and on the other hand the changing medium influences the fluid flow. This Research Topic Ebook presents current research illustrating the depth and breadth of ongoing work in the field of flow and transformation in porous media through 15 papers by 72 authors from around the world. The body of work highlights the challenges posed by the vast range of length- and time-scales over which subsurface flow processes occur. Importantly, phenomena from each scale contribute to the larger-scale behavior. The flow of oil and gas in reservoirs, and the flow of groundwater on catchment scale is sensitively linked to pore scale processes and material heterogeneity down to the micrometer scale. The geological features of the same reservoirs and catchments evolved over millions of years, sometimes as a consequence of cracking and fracture growth occurring on the time scale of microseconds. The research presented by the authors of this Research Topic represents a step toward bridging the separation of scales as well as the separation of scientific disciplines so that a more unified picture of flow and transformation in porous media can start to emerge.

Two-phase High Velocity Flow Through Porous Media Oxford University Press

Fluid and flow problems in porous media have attracted the attention of industrialists, engineers and scientists from varying disciplines, such as chemical, environmental, and mechanical engineering, geothermal physics and food science. There has been a increasing interest in heat and fluid flows through porous media, making this book a timely and appropriate resource. Each chapter is systematically detailed to be easily grasped by a research worker with basic knowledge of fluid mechanics, heat transfer and computational and experimental methods. At the same time, the readers will be informed of the most recent research literature in the field, giving it dual usage as both a post-grad text book and professional reference. Written by the recent directors of the NATO Advanced Study Institute session on 'Emerging Technologies and Techniques in Porous Media' (June 2003), this book is a timely and essential reference for scientists and engineers within a variety of fields.