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| 1. Record Nr. | UNISOBE600200016274 |
| Autore | Schafer, Roy |
| Titolo | L'interpretazione psicoanalitica del Rorschach : Teorie e applicazione / Roy Schafer |
| Pubbl/distr/stampa | Torino, : Boringhieri, 1975 |
| Descrizione fisica | 529 p. ; 25 cm |
| Collana | Serie di psicologia e psichiatria |
| Lingua di pubblicazione | Italiano |
| Formato | Materiale a stampa |
| Livello bibliografico | Monografia |
| 2. Record Nr. | UNINA9910818260103321 |
| Autore | Huang Haibo (Engineering professor) |
| Titolo | Multiphase lattice Boltzmann methods : theory and application // Haibo Huang, Michael C. Sukop, Xi-Yun Lu |
| Pubbl/distr/stampa | Chichester, [England] : , : Wiley Blackwell, , 2015
©2015 |
| ISBN | 1-118-97134-5
1-118-97145-0
1-118-97144-2 |
| Descrizione fisica | 1 online resource (390 p.) |
| Disciplina | 530.132 |
| Soggetti | Lattice Boltzmann methods
Multiphase flow
Fluid dynamics
Fluid dynamics - Mathematical models |
| Lingua di pubblicazione | Inglese |
| Formato | Materiale a stampa |
| Livello bibliografico | Monografia |
| Note generali | Description based upon print version of record. |
| Nota di bibliografia | Includes bibliographical references and index. |

Cover; Title Page; Copyright; Contents; Preface; About the companion website; Chapter 1 Introduction; 1.1 History of the Lattice Boltzmann method; 1.2 The Lattice Boltzmann method; 1.3 Multiphase LBM; 1.3.1 Color-gradient model; 1.3.2 Shan-Chen model; 1.3.3 Free-energy model; 1.3.4 Interface tracking model; 1.4 Comparison of models; 1.5 Units in this book and parameter conversion; 1.6 Appendix: Einstein summation convention; 1.6.1 Kronecker function; 1.6.2 Lattice tensors; 1.7 Use of the Fortran code in the book; Chapter 2 Single-component multiphase Shan-Chen-type model; 2.1 Introduction 2.1.1 "Equilibrium" velocity in the SC model 2.1.2 Inter-particle forces in the SC SCMP LBM; 2.2 Typical equations of state; 2.2.1 Parameters in EOS; 2.3 Thermodynamic consistency; 2.3.1 The SCMP LBM EOS; 2.3.2 Incorporating other EOS into the SC model; 2.4 Analytical surface tension; 2.4.1 Inter-particle Force Model A; 2.4.2 Inter-particle Force Model B; 2.5 Contact angle; 2.6 Capillary rise; 2.7 Parallel flow and relative permeabilities; 2.8 Forcing term in the SC model; 2.8.1 Schemes to incorporate the body force; 2.8.2 Scheme overview; 2.8.3 Theoretical analysis 2.8.4 Numerical results and discussion 2.9 Multirange pseudopotential (Inter-particle Force Model B); 2.10 Conclusions; 2.11 Appendix A: Analytical solution for layered multiphase flow in a channel; 2.12 Appendix B: FORTRAN code to simulate single component multiphase droplet contacting a wall, as shown in Figure 2.7(c); Chapter 3 Shan and Chen-type multi-component multiphase models; 3.1 Multi-component multiphase SC LBM; 3.1.1 Fluid-fluid cohesion and fluid-solid adhesion; 3.2 Derivation of the pressure; 3.2.1 Pressure in popular papers (2D); 3.2.2 Pressure in popular papers (3D) 3.3 Determining G_c and the surface tension 3.4 Contact angle; 3.4.1 Application of Young's equation to MCMP LBM; 3.4.2 Contact angle measurement; 3.4.3 Verification of proposed equation; 3.5 Flow through capillary tubes; 3.6 Layered two-phase flow in a 2D channel; 3.7 Pressure or velocity boundary conditions; 3.7.1 Boundary conditions for 2D simulations; 3.7.2 Boundary conditions for 3D simulations; 3.8 Displacement in a 3D porous medium; Chapter 4 Rothman-Keller multiphase Lattice Boltzmann model; 4.1 Introduction; 4.2 RK color-gradient model 4.3 Theoretical analysis (Chapman-Enskog expansion) 4.3.1 Discussion of above formulae; 4.4 Layered two-phase flow in a 2D channel; 4.4.1 Cases of two fluids with identical densities; 4.4.2 Cases of two fluids with different densities; 4.5 Interfacial tension and isotropy of the RK model; 4.5.1 Interfacial tension; 4.5.2 Isotropy; 4.6 Drainage and capillary filling; 4.7 MRT RK model; 4.8 Contact angle; 4.8.1 Spurious currents; 4.9 Tests of inlet/outlet boundary conditions; 4.10 Immiscible displacements in porous media; 4.11 Appendix A; 4.12 Appendix B Chapter 5 Free-energy-based multiphase Lattice Boltzmann model

Theory and Application of Multiphase Lattice Boltzmann Methods presents a comprehensive review of all popular multiphase Lattice Boltzmann Methods developed thus far and is aimed at researchers and practitioners within relevant Earth Science disciplines as well as Petroleum, Chemical, Mechanical and Geological Engineering. Clearly structured throughout, this book will be an invaluable reference on the current state of all popular multiphase Lattice Boltzmann Methods (LBMs). The advantages and disadvantages of each model are presented in an accessible manner to enable the reader to choose the