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| Nota di contenuto       | Cover; DIRECT NUMERICAL SIMULATIONS OF GAS-LIQUID MULTIPHASE FLOWS; Title; Copyright; Contents; Preface; 1 Introduction; 1.1 Examples of multiphase flows; 1.2 Computational modeling; 1.2.1 Simple flows (Re = 0 and Re = 8); 1.2.2 Finite Reynolds number flows; 1.3 Looking ahead; 2 Fluid mechanics with interfaces; 2.1 General principles; 2.2 Basic equations; 2.2.1 Mass conservation; 2.2.2 Momentum conservation; 2.2.3 Energy conservation; 2.2.4 Incompressible flow; 2.2.5 Boundary conditions; 2.3 Interfaces: description and definitions; 2.4 Fluid mechanics with interfaces 2.4.1 Mass conservation and velocity conditions2.4.2 Surface tension; 2.4.3 Momentum conservation with interfaces; 2.4.4 Free-surface flow; 2.5 Fluid mechanics with interfaces: the one-fluid formulation; 2.6 |

Nondimensional numbers; 2.7 Thin films, intermolecular forces, and contact lines; 2.7.1 Disjoining pressure and forces between interfaces; 2.7.2 Contact line statics and dynamics; 2.8 Notes; 2.8.1 Fluid and interface mechanics; 2.8.2 Thin films and contact lines; 3 Numerical solutions of the Navier-Stokes equations; 3.1 Time integration; 3.2 Spatial discretization  
 3.3 Discretization of the advection terms  
 3.4 The viscous terms; 3.5 The pressure equation; 3.6 Velocity boundary conditions; 3.7 Outflow boundary conditions; 3.8 Adaptive mesh refinement; 3.9 Summary; 3.10 Postscript: conservative versus non-conservative form; 4 Advecting a fluid interface; 4.1 Notations; 4.2 Advecting the color function; 4.3 The volume-of-fluid (VOF) method; 4.4 Front tracking; 4.5 The level-set method; 4.6 Phase-field methods; 4.7 The CIP method; 4.8 Summary; 5 The volume-of-fluid method; 5.1 Basic properties; 5.2 Interface reconstruction  
 5.2.1 Convergence order of a reconstruction method  
 5.2.2 Evaluation of the interface unit normal; 5.2.3 Determination of  $\alpha$ ; 5.3 Tests of reconstruction methods; 5.3.1 Errors measurement and convergence rate; 5.3.2 Reconstruction accuracy tests; 5.4 Interface advection; 5.4.1 Geometrical one-dimensional linear-mapping method; 5.4.2 Related one-dimensional advection methods; 5.4.3 Unsplit methods; 5.5 Tests of reconstruction and advection methods; 5.5.1 Translation test; 5.5.2 Vortex-in-a-box test; 5.6 Hybrid methods; 6 Advecting marker points: front tracking; 6.1 The structure of the front  
 6.1.1 Structured two-dimensional fronts  
 6.1.2 Unstructured fronts; 6.2 Restructuring the fronts; 6.3 The front-grid communications; 6.3.1 Locating the front on the fixed grid; 6.3.2 Interpolation and smoothing; 6.4 Advection of the front; 6.5 Constructing the marker function; 6.5.1 Constructing the marker function from its gradient; 6.5.2 Construction of the volume fraction from the front location; 6.6 Changes in the front topology; 6.7 Notes; 7 Surface tension; 7.1 Computing surface tension from marker functions; 7.1.1 Continuous surface force method; 7.1.2 Continuous surface stress method  
 7.1.3 Direct addition and elementary smoothing in the VOF method

## Sommario/riassunto

Accurately predicting the behaviour of multiphase flows is a problem of immense industrial and scientific interest. Modern computers can now study the dynamics in great detail and these simulations yield unprecedented insight. This book provides a comprehensive introduction to direct numerical simulations of multiphase flows for researchers and graduate students. After a brief overview of the context and history the authors review the governing equations. A particular emphasis is placed on the 'one-fluid' formulation where a single set of equations is used to describe the entire flow field and interface terms are included as singularity distributions. Several applications are discussed, showing how direct numerical simulations have helped researchers advance both our understanding and our ability to make predictions. The final chapter gives an overview of recent studies of flows with relatively complex physics, such as mass transfer and chemical reactions, solidification and boiling, and includes extensive references to current work.