1. Record Nr. UNINA9910592981803321

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Titolo	Rarefied gas dynamics : kinetic modeling and multi-scale simulation / / Lei Wu
Pubbl/distr/stampa	Singapore : , : Springer, , [2022] ©2022
ISBN	9789811928727 9789811928710
Descrizione fisica	1 online resource (293 pages) : illustrations (black and white, and colour)
Disciplina	533.2
Soggetti	Rarefied gas dynamics - Mathematical models Rarefied gas dynamics
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Note generali	Includes index.
Nota di contenuto	Intro -- Preface -- Contents -- 1 Introduction -- 1.1 Navier-Stokes-Fourier Equations -- 1.2 Continuum Breakdown -- 1.2.1 Reentry of Space Vehicle -- 1.2.2 Microelectromechanical Systems -- 1.2.3 Shale Gas Extraction -- 1.2.4 Global Wind Profiling -- 1.3 Simple Gas Kinetic Theory -- 1.4 Knudsen Number -- 1.4.1 Spatial Knudsen Number -- 1.4.2 Temporal Knudsen Number -- 1.5 Molecular Dynamics Simulations -- References -- 2 Gas Kinetic Theory -- 2.1 Velocity Distribution Function -- 2.2 Binary Collision -- 2.2.1 Deflection Angle -- 2.2.2 Differential Cross Section -- 2.2.3 Grazing Collision -- 2.3 Boltzmann Equation -- 2.3.1 H-Theorem -- 2.3.2 Equilibrium Collision Frequency -- 2.3.3 Linearized Boltzmann Equation -- 2.4 Wang-Chang and Uhlenbeck Equation -- 2.5 Enskog Equation -- 2.5.1 Liquid-Vapor Flow -- 2.5.2 Granular Gas -- 2.6 Gas-Surface Boundary Condition -- 2.6.1 Maxwell Boundary Condition -- 2.6.2 Epstein Boundary Condition -- 2.6.3 Cercignani-Lampis Boundary Condition -- 2.7 Numerical Methods -- 2.7.1 Direct Simulation Monte Carlo -- 2.7.2 Discrete Velocity Methods -- 2.7.3 Multi-scale Simulation -- References -- 3 Fluid-Dynamic Equation -- 3.1 Hilbert Expansion -- 3.2 Chapman-Enskog Expansion -- 3.2.1 Expansion in Sonine Polynomials -- 3.2.2 Expansion to the First Order -- 3.2.3 Expansion to Higher Orders --

Sommario/riassunto

This book highlights a comprehensive description of the numerical methods in rarefied gas dynamics, which has strong applications ranging from space vehicle re-entry, micro-electromechanical systems, to shale gas extraction. The book consists of five major parts: The fast spectral method to solve the Boltzmann collision operator for dilute monatomic gas and the Enskog collision operator for dense granular gas; The general synthetic iterative scheme to solve the kinetic equations with the properties of fast convergence and asymptotic preserving; The kinetic modeling of monatomic and molecular gases, and the extraction of critical gas parameters from the experiment of Rayleigh-Brillouin scattering; The assessment of the fluid-dynamics equations derived from the Boltzmann equation and typical kinetic gas-surface boundary conditions; The applications of the fast spectral method and general synthetic iterative scheme to reveal the dynamics in some canonical rarefied gas flows. The book is suitable for postgraduates and researchers interested in rarefied gas dynamics and provides many numerical codes for them to begin with.