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Nota di bibliografia	Includes bibliographical references and index.
Nota di contenuto	Contents; 1 The magnetohydrodynamics equations; 1.1 The general fluid equations; 1.1.1 The conservation equations; 1.1.2 Boundary and initial conditions; 1.1.3 Steady-state equations; 1.2 The electromagnetic description; 1.3 The MHD coupling; 1.3.1 The general MHD system; 1.3.2 A commonly used simplified MHD coupling; 1.3.3 The density-dependent case; 1.4 Other MHD models; 1.5 The MHD system considered in the sequel; 1.6 Non-dimensionalized equations; 2 Mathematical analysis of one-fluid problems; 2.1 Mathematical results on the incompressible homogeneous Navier-Stokes equations 2.1.1 Some basics2.1.2 The illustrative example of the two-dimensional case; 2.1.3 The three-dimensional hydrodynamic case; 2.1.4 Related issues; 2.2 Mathematical results on the one-fluid MHD equations; 2.2.1 A brief overview of the literature; 2.2.2 Mathematical analysis; 2.2.3 Back to the hyperbolic system; 2.2.4 Stationary problems; 2.2.5 A hybrid problem; 2.2.6 Other MHD models and formulations; 3 Numerical approximation of one-fluid problems; 3.1 A

general framework for problems with constraints; 3.1.1 A model problem: the Stokes equations; 3.1.2 Abstract framework for a linear problem
3.1.3 Application to the Stokes problem3.1.4 The inf-sup condition; 3.1.5 The mixed Galerkin method; 3.1.6 Algebraic aspects; 3.1.7 Mixed finite element for the Stokes problem; 3.1.8 Extension to nonlinear problems; 3.2 A glance at stabilized finite elements; 3.3 Mixed formulations of the stationary MHD equations; 3.3.1 A formulation for convex polyhedra and regular domains; 3.3.2 A formulation for non-convex polyhedra; 3.4 Mixed finite elements for MHD; 3.4.1 Mixed finite elements on convex polyhedra and regular domains; 3.4.2 Mixed finite elements on non-convex polyhedra
3.5 Stabilized finite elements for MHD3.6 Solution strategy and algebraic aspects; 3.6.1 Fully coupled iterations for stationary problems; 3.6.2 Decoupled iterations for stationary problems; 3.6.3 Fully coupled iterations for transient problems; 3.6.4 MHD versus Navier-Stokes solvers; 3.7 Examples of test cases and simulations; 3.7.1 Hartmann flows; 3.7.2 A fluid carrying current in the presence of a magnetic field; 3.7.3 Convergence of nonlinear algorithms; 3.8 About the boundary conditions; 3.8.1 First set of boundary conditions; 3.8.2 Second set of boundary conditions
3.8.3 Practical implementation of the boundary conditions4 Mathematical analysis of two-fluid problems; 4.1 The difficulties of the non-homogeneous case; 4.1.1 A formal mathematical argument; 4.1.2 The major ingredient; 4.1.3 Short overview of the state of the art for the hydrodynamic case; 4.2 Weak solutions of the multifluid MHD system; 4.2.1 Mathematical setting of the equations; 4.2.2 Existence of a weak solution; 4.3 On the long-time behavior; 4.3.1 The nonlinear hydrodynamics case; 4.3.2 A detour by linearized models; 4.3.3 The MHD case; 5 Numerical simulation of two-fluid problems
5.1 Numerical approximations in the ALE formulation

Sommario/riassunto

Aimed at research mathematicians, engineers and physicists, as well as those in industry, the approach of this text is highly mathematical and based on solid numerical analysis. It focuses on mathematical and numerical techniques for the simulation of magnetohydrodynamic phenomena, with an emphasis on industrial applications.
