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Autore	Touzani Rachid
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Nota di bibliografia	Includes bibliographical references and index.
Nota di contenuto	Part I Eddy Current Models -- Mathematical framework -- Introduction -- Preliminaries.- The Three-Dimensional Case -- The Two-Dimensional Case -- Maxwell and eddy current equations -- Introduction -- Maxwell equations -- Low frequency approximation -- Static cases.- Time{Harmonic Regime -- Eddy Current Equations -- Two-dimensional models.- Introduction -- A solenoidal two-dimensional model -- A transversal model -- Three-dimensional models.- A current density formulation -- A magnetic field formulation -- An electric field model -- Axisymmetric models -- Axisymmetric setting -- A magnetic field model -- A scalar potential model -- Eddy current models with thin inductors -- The two-dimensional solenoidal model -- The two-dimensional transversal model -- Three-dimensional models -- Numerical Methods -- Introduction and main notations -- Standard (H1) finite element method -- A finite element method for the 2-D solenoidal model -- Finite elements for the axisymmetric model.- Finite elements in H(curl){spaces.- Finite elements in H(div){spaces -- The boundary element

method for boundary integral equations -- Approximation of a domain integral equation -- Coupled finite element/boundary element methods -- Part II Selected Applications -- Induction Heating Processes.- A mathematical model.- Bibliographical comments -- A 2-D stationary problem -- A 2-D time dependent problem.- Numerical experiments.- An optimal control problem -- Magnetohydrodynamics and Magnetic Shaping -- Incompressible Magnetohydrodynamics. - Eddy current free boundary problems.- An Electromagnetic Casting problem -- Inductively coupled plasma torches.- The model. - Numerical approximation -- A numerical simulation.- Ferromagnetic Shielding.- Mathematical analysis.- An iterative procedure.- Solution of the linear problem by a domain decomposition method.- An iterative procedure for the discrete nonlinear problem.- Numerical results.- The electrolytic process for aluminium production -- Introduction.- The model -- Numerical approximation -- Numerical results -- Mathematical Symbols -- References -- Index.

Sommario/riassunto

This monograph addresses fundamental aspects of mathematical modeling and numerical solution methods of electromagnetic problems involving low frequencies, i.e. magnetostatic and eddy current problems which are rarely presented in the applied mathematics literature. In the first part, the authors introduce the mathematical models in a realistic context in view of their use for industrial applications. Several geometric configurations of electric conductors leading to different mathematical models are carefully derived and analyzed, and numerical methods for the solution of the obtained problems are given. Related issues such as convergence of the approximations and error estimates are discussed. The second part of the monograph presents various coupled problems that involve eddy current or magnetostatic problems, in particular magneto-hydrodynamic problems and magnetic shaping problems concerning the melt flow of electrically conducting metals, induction heating processes, inductively coupled plasmas and ferromagnetic screening modeling. The presentation of each model comes with numerical illustration from industrial applications.