The aims of the book are to present a survey of the simulation of ferromagnetic hysteresis and its importance in electromagnetic field computation from electrical engineering point of view, and the implementation of hysteresis models in the Finite Element Method. The book starts with a summary of Maxwells equations, their form in case of nonlinear static magnetic field problems and nonlinear eddy current field problems. The description of the possible potential formulations used in solving static magnetic field and eddy current field problems is presented. Finite Element Method is a possible technique to solve numerically the partial differential equations formulated by using the weak form. The review of the Finite Element Method is followed by the study of nodal finite elements as well as the newer vector elements. The modeling and measuring aspects of ferromagnetic hysteresis based on the authors experiments are discussed next. A short summary of the fundamentals in magnetism and magnetic materials is also introduced. The Preisach model is presented as well as the neural network based scalar and vector hysteresis models developed by the authors. The method of identification of hysteresis models is also given. One chapter presents the polarization method as well as the fixed-point technique to solve nonlinear electromagnetic field problems. Nonlinear equations obtained from Maxwells equations can be formulated as a fixed-point equation. This method results in a convergent numerical tool to solve nonlinear equations. The book is closed by a collection of seven problems solved by the nonlinear Finite Element Method applying the user-friendly graphical user interface and functions of COMSOL Multiphysics.

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Accurate and simple magnetic material law is necessary to correctly model complete electromagnetic systems. By using such formulation, space discretization techniques (finite differences, finite elements) are avoided which are highly space and time consuming while keeping the global simulation results precise. The finite element method is a possible technique to solve numerically the partial differential equations formulated by using the weak form. It is noted here that the finite element method is one of the most widely used methods to solve electromagnetic field problems.

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