

Numerical simulation of magnetic inspection processes

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Abstract

A very commonly used method for non-destructive inspection of ferromagnetic materials is the magnetic flux leakage technique. The main idea is to apply a strong magnetic field to the part to be inspected, and look for the expulsion of magnetic flux lines produced by any defects. The detection of the leaked field can be done while applying the magnetic field, or using the residual magnetization obtained after turning off the field source. In this talk we will briefly describe the main aspects of the technique, and highlight some of the more interesting modeling issues. We will discuss some ideas on how to discretize Maxwell's equations through the coupling of the boundary element method for the exterior problem to the finite element method for the problem inside the ferromagnetic pieces, and show some numerical results. We will also introduce the Preisach hysteresis models and comment on their application to the computation of the residual magnetization and magnetic field. Some references will also be made to the simulation of the demagnetization process, which has a significant practical importance.