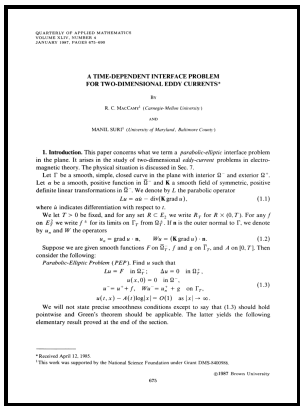
Solving time-dependent two-dimensional eddy current problems

National Aeronautics and Space Administration - Finite Element Differential



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A TIME-DEPENDENT INTERFACE PROBLEM
FOR TWO-DIMENSIONAL EDDY CURRENTS*

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1. Introduction. This paper concerns what we term a *parabolic-elliptic* interface problem in the plane. It arises in the study of two-dimensional *eddy-current* problems in electromagnetic theory. The physical situation is discussed in Sec. 7.

Let Γ be a smooth, simple, closed curve in the plane with interior Ω^- and exterior Ω^+. Let α be a smooth, positive function in $\bar{\Omega}^-$ and $\mathbf{K}$ a smooth field of symmetric, positive definite linear transformations in Ω^-. We denote by L the parabolic operator

$$Lu = \alpha u - \operatorname{div}(\mathbf{K} \operatorname{grad} u), \tag{1.1}$$

where a indicates differentiation with respect to t.

We let $T > 0$ be fixed, and for any set $R \subset E_2$ we write R_T for $R \times (0, T)$. For any f on $\bar{E}_2^-$ we write f^+ for its limits on Γ_T from Ω_T^-. If n is the outer normal to Γ, we denote by u_n and Wu the operators

$$u_n = \operatorname{grad} u \cdot n, \qquad Wu = (\mathbf{K} \operatorname{grad} u) \cdot n. \tag{1.2}$$

Suppose we are given smooth functions F on $\bar{\Omega}_T^-$, f and g on Γ_T, and A on $[0, T]$. Then consider the following:

Parabolic-Elliptic Problem (PEP). Find u such that

$$\begin{aligned} Lu &= F \quad \text{in } \Omega_T^-; \qquad \Delta u = 0 \quad \text{in } \Omega_T^+; \\ u(x, 0) &= 0 \quad \text{in } \Omega^-; \\ u^- &= u^+ + f, \quad Wu^- = u_n^+ + g \quad \text{on } \Gamma_T, \\ u(x, t) &- A(t) \log|x| = O(1) \quad \text{as } |x| \to \infty. \end{aligned} \tag{1.3}$$

We will not state precise smoothness conditions except to say that (1.3) should hold pointwise and Green's theorem should be applicable. The latter yields the following elementary result proved at the end of the section.

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Description: -
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Eddy currents (Electric)
Maxwell equations.Solving time-dependent two-dimensional eddy current problems
-
NASA technical memorandum -- 100875Solving time-dependent two-dimensional eddy current problems
Notes: Microfiche. [Washington, D.C.? : National Aeronautics and Space Administration], 1988. 1 microfiche.
This edition was published in 1988

Tags: #Phys. #Rev. #A #42, #6831 #(1990)

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The problem is discretized using linear edge shape functions with 2269 in space and on a fine equidistant time grid with 2 14 intervals using backward Euler to resolve the pulses. For simplicity, a two-dimensional transverse magnetic field which is incident on an infinitely long conductor is considered.

Phys. Rev. A 42, 6831 (1990)

As an illustration, we use this optimal basis-set expansion to solve a simplified two-dimensional free-electron laser model that can be formulated in terms of a TDS equation. Two-scale homogenization of the nonlinear eddy current problem with FEM. MacCamy, Integral equation procedures for eddy current problems, J.

Phys. Rev. A 42, 6831 (1990)

In a symmetrical stator winding, the MMF harmonic components are phase-belt harmonics with order of 2 q ± 1 , stator slot harmonics with order of N s ± p , and rotor slot harmonics with order of N r ± p. A nonlinear time domain homogenization technique for laminated iron cores in three-dimensional finite-element models. Proofs of completeness and optimization prescriptions are given in a general way, suggesting that this technique can be used to solve a broad class of TDS equations.

Phys. Rev. A 42, 6831 (1990)

The level of discretization of the volume of the calculated area is schematically shown in Fig.

CiteSeerX — A Backward Euler

IEEE Transactions on Magnetics, 2010, vol. These include scattering from composites and lossy dielectrics as well as modeling of flaws and inclusions.

Finite Element Differential

The analysis of the B field is very critical to understand the harmonic components of electromagnetic forces since the electromagnetic forces are often found to be the major noise and vibration source in many cases.

Multigrid

Dependences of specific losses in the laminated model from flux density Caption: Fig.

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