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Numerical solution of transient eddy current problems with input current intensities as boundary data

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Abstract

The aim of this talk is to analyze a numerical method to solve transient eddy current problems with input current intensities as data, formulated in terms of the magnetic field in a bounded domain including conductors and dielectrics ([1]). To this end, we introduce a time-dependent weak formulation and prove its well-posedness ([2]). Under appropriate hypotheses on the input current intensities, following [3] we show that the weak solution has additional regularity and satisfies strong forms of the equations. We propose a finite element method for space discretization based on Nédélec edge elements on tetrahedral mesh, for which we prove well-posedness and error estimates. Furthermore, we introduce an implicit Euler scheme for time discretization and prove error estimates for the fully discrete problem. Moreover, a magnetic scalar potential is introduced to deal with the curl-free condition in the dielectric domain. This approach leads to an important saving in computational effort. Finally, the method is applied to solve two problems: a test with a known analytical solution and an application to electromagnetic forming.

References

[1] Bermúdez, A., Rodríguez, R., & Salgado, P. *Numerical solution of eddy current problems in bounded domains using realistic boundary conditions.* Computer Methods in Applied Mechanics and Engineering, vol. 194, 2-5, pp. 411–426, (2005).

[2] Dautray, R. & Lions, J-L. Mathematical Analysis and Numerical Methods for Science and Technology, Volume 5, Evolution Problems I. Springer–Verlag, Berlin, 1992.

[3] Evans, L.C. Partial Differential Equations. American Mathematical Society, Providence, RI. 1998.

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