

Impedance transmission conditions for thin conducting sheets

KERSTEN SCHMIDT¹, SÉBASTIEN TORDEUX²

¹INRIA Paris-Roquencourt, kersten.schmidt@inria.fr

²INSA Toulouse, sebastien.tordeux@insa-toulouse.fr

Thin shielding sheets in low frequency electromagnetic devices are difficult to model within the eddy current model when using standard FE discretisations. This is due to the smallness of the layer which would lead to a huge number of elements in and around the sheet. The sheets are therefore replaced by impedance transmission conditions [1–3], similarly to impedance boundary conditions for thin coatings. The previous conditions turn out to be of first order in the sheet thickness [4]. For the case of smooth sheets, we will present frameworks to derive impedance transmission conditions to any order [5, 6] and show results up to third order. We will discuss the stability, robustness w.r.t. to frequency (or equivalently skin depth) of the impedance boundary conditions as well as their use in variational formulations like in a FE discretisation. Numerical results will verify the theoretical findings.

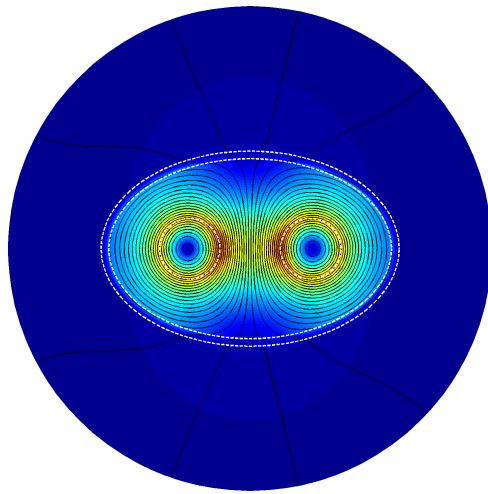


Figure 1: Magnetic fields around two live wires shielded by an ellipsoidal thin conducting sheet.

References

- [1] H. IGARASHI, A. KOST, AND T. HONMA. Impedance boundary condition for vector potentials on thin layers and its application to integral equations. *Eur. Phys. J. AP 1* (1998), 103–109.
- [2] L. KRÄHENBÜHL, AND D. MULLER. Thin layers in electrical engineering. Example of shell models in analysing eddy-currents by boundary and finite element methods. *IEEE Trans. Magn. 29* (1993), 1450–1455.
- [3] MAYERGOYZ, I., AND BEDROSIAN, G. On calculation of 3-D eddy currents in conducting and magnetic shells. *IEEE Trans. Magn. 31*, 3 (1995), 1319–1324.
- [4] SCHMIDT, K. *High-order numerical modeling of highly conductive thin sheets*. PhD thesis, ETH Zurich, July 2008.
- [5] SCHMIDT, K., AND TORDEUX, S. Asymptotic modelling of conductive thin sheets. *Z. Angew. Math. Phys.* (2010). in print.
- [6] SCHMIDT, K., AND TORDEUX, S. High order transmission conditions for thin conductive sheets in magneto-quasistatics. INRIA report 7254, INRIA, April 2010.