A guaranteed a posteriori error estimator for certified boundary variation algorithm

Matteo Giacomini
Centre de Mathématiques Appliquées, Ecole Polytechnique
Route de Saclay, 91128 Palaiseau, France

matteo.giacomini@polytechnique.edu

We consider the identification problem of Electrical Impedance Tomography.
It is known in the literature that the error introduced by the numerical approximation of this problem may prevent the classical boundary variation algorithm from converging to a sequence of minimizing shapes. We account for the numerical error due to the Finite Element discretization by means of an *a posteriori* estimator that provides a guaranteed upper bound of the error in the shape derivative. Thus, we perform goal-oriented mesh adaptivity to iteratively adapt the computational grid at each iteration until a genuine descent direction for the gradient algorithm is identified.
The resulting guaranteed shape optimization strategy is applied to identify an inclusion within an electric body by performing only boundary measurements. Some numerical simulations using `FreeFem++` are presented.

References

[1] G. Allaire, O. Pantz. *Structural optimization with* ***FreeFem++*** . Struct. Multidiscip. Optim. 32:3 (2006).

[2] R. Becker, R. Rannacher. *An optimal control approach to a posteriori error estimation in Finite Element Methods*. Acta Numerica, 10:1-102 (2001).

[3] A. Ern, A. Stephansen. *A posteriori energy-norm error estimates for advection-diffusion equations approximated by weighted interior penalty methods*. J. Comp. Math., 26:488-510 (2008).

[4] M. Giacomini, O. Pantz, K. Trabelsi. *An adaptive shape optimization strategy driven by fully-computable goal-oriented error estimators*. (In preparation).

[5] F. Hecht. *New development in* ***FreeFem++***. J. Numer. Math., 20(3-4):251-265 (2012).

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