Shape Optimization in Magnetostatics

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Shape optimization via pursuing diffeomorphism: an application to electromagnetic induction heating.

The implementation of a solver for a shape optimization problem via pursuing diffeomorphism is described, discussed and tested. The problem at hand consists in finding an optimal shape for a toroidal conductor employed in electromagnetic induction heating. Electric currents inside the conductor are evaluated using a scalar potential approach, recovered solving an underlying Partial Differential Equation with a Finite-Element discretization that has been tuned to take discontinuities into account. The magnetic field on the object that needs to be heated is instead computed applying Biot-Savart law. The shape itself is described in a parametric manner, using a map built on B-spline basis functions. With regards to the optimization algorithm, a steepest descent method is employed.

The code is written using the template library BETL2 developed at ETH, and it is here described with a focus on computational performance and memory usage. Relevant parts of the implementation are tested and validated. Numerical convergence results are reported and discussed for various experiments conducted.