

A level set shape optimization method for an elliptic obstacle problem

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We construct a level set method for an elliptic obstacle problem, which can be reformulated as a shape optimization problem. We provide a detailed shape sensitivity analysis for this reformulation and a stability result for the shape Hessian at the optimal shape.

Using the shape sensitivities we construct a geometric gradient flow, which can be realized in the context of level set methods. We prove the convergence of the gradient flow to an optimal shape and provide a complete analysis of the level set method in terms of viscosity solutions. To our knowledge this is the first complete analysis of a level set method for a nonlocal shape optimization problem.

Finally, we discuss the implementation of the methods and illustrate its behavior through several computational experiments.