

Shape optimization for free boundary problems

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Abstract:

We consider a Bernoulli type exterior free boundary problem which serves as a prototype of many shape optimization problems. We focus on three different formulations, including the tracking of either the Neumann or the Dirichlet data.

We compute the boundary integral representations of the related shape gradients and Hessians. With the shape Hessian at hand we are able to investigate sufficient second order optimality conditions. For all formulations we derive the same sufficient criterion for stable minimizers. However, it turns out that the tracking of the Dirichlet data is ill-posed.

We finally discuss the numerical solution of the shape optimization problems by means of boundary integral equations which we are going to solve by a wavelet-based fast boundary element method. Numerical experiments support and quantify the theoretical findings.