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A shape optimization approach for solving a geometric inverse problem of Bernoulli's type

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Abstract

This work is devoted to the numerical investigation of a geometric inverse problem of Bernoulli type, reformulated as a shape optimization problem, involving a volume shape cost functional. So, based on the Hadamard shape derivative approach of [2, 1], we establish the existence of the first-order shape derivative of the considered cost functional and express its shape derivative formula. Then, in order to analyze the stability of the shape optimization problem and enhance the ill-posedness of this kind of inverse problems, we derive the second-order shape derivative of the cost functional and study the continuity and coercivity of the resulting shape Hessian. Finally, the obtained numerical results, by using a gradient-based optimization process combined with the finite element method for solving this optimization problem, confirm the numerical stability and efficiency of the proposed approach.

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References

- [1] Delfour, M., C. and Zolésio, J., P., Shapes and geometries: metrics, analysis, differential calculus, and optimization. Siam, 22, 2011.
- [2] Henrot, A., and Pierre, M., Shape Variation and Optimization : A Geometrical Analysis, EMS Tracts in Mathematics, European Mathematical Society, 2018.