An Adaptive Finite Element Procedure for Shape Optimization Problems

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The numerical investigation of shape optimization problems is both computationally and theoretically more complex than solving direct analysis problems using the finite element method. The limitations are mainly due to the involvement of both structural analysis and optimization processes. To overcome these numerical challenges, we present an adaptive algorithm for solving the shape optimization problem associated with the compliance minimization objective with penalized volume fraction. This approach takes into account not only the errors due to the discretization of the constraining PDE, in particular the linear elasticity system, but also the errors due to the discretization of the deformation bilinear form that provides a descent direction. The proposed adaptive procedure is tested on the well-known compliance minimization problem of cantilever beam to illustrate the superiority of the adaptive procedure compared to the fixed mesh refinement.

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