Topology optimisation using level set methods and the discontinuous Galerkin method

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Abstract

This paper presents a topology optimisation approach that combines an adjoint-based sensitivity analysis, [1], with level set methods (LSM), [2], for front propagation, and the discontinuous Galerkin (DG) symmetric interior penalty (SIP) method, [3]. The problems considered in this paper will be limited to the minimum compliance design of two-dimensional linear elastic structures.

The boundary of the interior 'voids' will be defined implicitly using a level set function and modelled as an 'ersatz material'. The optimal shape of the boundary is found by the propagation of the boundary, which occurs through the evolution of the level set function in pseudo-time which is governed by a Hamilton-Jacobi equation. The advection velocity of the Hamilton-Jacobi equation is defined as the topological derivative of the objective functional, which is computed using an adjoint problem. The main novelty of this paper is that both the physical model and the boundary propagation model will be discretised using the DGSIP method. Also, various PDE-based level set reinitialisation methods will be implemented to test their effects on convergence.

Keywords: Topology optimisation, level set methods, discontinuous Galerkin method, symmetric interior penalty.

References

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