11th World Congress on Structural and Multidisciplinary Optimisation
07th -12th, June 2015, Sydney Australia

Achieving Minimum Length Scale in Topology Optimization by Geometric Constraints

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Abstract

A topology optimization approach is presented to design structures with strict minimum length scale. The idea is inspired from the work on topology optimization with robust formulations [1, 2, 3], where the optimized nominal design possess minimum length scale if all the considered design realizations in the problem formulation share a consistent topology. However, the latter condition may not be satisfied depending on physical problems [2]. In the current study, two differentiable geometric constraints are formulated based on a filtering-threshold modelling scheme. Satisfying the constraints leads to designs with controllable minimum length scale on both solid and void phases. No additional finite element analysis is required for the constrained problem. Conventional topology optimization can be easily extended to impose minimum length scale on the final design with the proposed constraints. Numerical examples of designing a compliant mechanism and a slow-light waveguide are presented to show the effectiveness of this approach.

Keywords: topology optimization, minimum length scale, geometric constraint.

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