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Topology Optimization with Non-probabilistic Load Uncertainty

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Abstract

In this paper, a topology optimization method with non-probabilistic external load uncertainty is presented. The load uncertainty is described by an unknown-but-bounded model [1, 2]. To obtain the optimized design, a maximum strain energy problem is formulated to find the worst loading case under uncertainty. It is often formulated as a two-level optimization problem [3]: the upper level optimization problem is a deterministic topology optimization under the worst loading case, and the lower level optimization problem is to find this worst loading case under load uncertainty.

One of the major challenges of the above formulation is that the lower level optimization problem is a concave problem which is very difficult to be solved numerically. To overcome this issue, an inhomogeneous eigenvalue problem is derived from the KKT conditions and the optimal solution of the lower level optimization problem can be obtained from the solutions of the inhomogeneous eigenvalue problem. Hence, the lower level optimization problem can be solved without numerical iterations. A few numerical examples are presented to demonstrate the effectiveness of the proposed topology optimization with an unknown-but-bounded external load uncertainty.

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