ROBUST TOPOLOGY OPTIMIZATION OF CONTINUUM STRUCTURES USING ISOLINES AND FIXED GRID UNDER LOADING UNCERTAINTY

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Uncertainty is a crucial aspect in structural optimization to produce robust and reliable topology solutions. The classical engineering approaches deal with uncertainties using factor of safety. However, this strategy can provide conservative solutions.

Recent years have witnessed growing interest in a probabilistic approach to represent, propagate and characterize uncertainties in the optimization process. The present approaches to take into account uncertainties in topology optimization are mainly classified in two categories. The first is named Reliability-Based Topology Optimization (RBTO) and the second is named Robust Topology Optimization (RTO). This the last years, this latter approach has become more a more popular in the last years, and it focuses on searching solutions insensitive to the effect of uncertainties. This approach transforms the robust problem into a deterministic one with multiple loads cases.

In this work is presented a new efficient and accurate approach to robust structural topology optimization under loading uncertainty. The objective is to minimize a weighted sum of the mean and standard deviation of structural compliance. Loading uncertainty are assumed statistically independent and can be described by any probability density function (pdf). The dimension-reduction method combined with Gauss-type quadrature sampling is then employed for calculating the mean and standard deviation of the response. This technique combination reduces greatly reduces the computational cost. To reach this goal, the structural boundary is defined by B-spline curve, and its control points are used as design variables. The topology is modified by adding or removing material according to a criterial level of isoline. Fixed grid-finite element analysis is used to obtain the stiffness of each elements. The validity of this technique is demonstrated on several examples, including different pdf, mean and standard deviation.

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