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

A level set method for the representation of multiple types of boundaries and its application in structural shape and topology optimization

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Abstract

A level set method is developed for representation of multiple types of boundaries, and it is applied in two structural shape and topology optimization problems. The first problem is the optimization of both structure and support, where both the homogeneous Neumann boundary and the Dirichlet boundary are optimized. The second problem is the optimization of structures subjected to pressure load, where both the non-homogeneous and homogeneous Neumann boundaries are optimized.

A fundamental issue of the present study is that how to represent different types of boundaries of a structure. In order to address this issue, a new scheme of representation through two level set functions is proposed. The two types of boundaries in the optimization problems are represented separately and are allowed to be continuously propagated during the optimization.

The concept of using multiple level set functions in the structural shape and topology optimization had been introduced in the design of structures that have several different materials [1-2]. The idea is to use n level set functions to represent up to 2^n different materials. In the present study, two level set functions are not used to represent multiple regions of different materials, but they are used to represent two different types of boundaries.

The optimization problem of minimum compliance is considered. The numerical examples demonstrated that the proposed method is effective.

References

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