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

Method of Variable Transformation for Topology Optimization with Clear Boundary Shape

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Abstract

The problem of topology optimization based on the density-based approach using gradient optimization methods is considered in the paper. The filtering procedure is used to avoid local minima and to control the topology design. Commonly this procedure is applied to the sensitivity field, since filtering of the design variables leads to strong blur solutions. To overcome these blurring an additional procedure is required.

In this paper both sensitivity filter and density filter are used. But for the density filter the following new approach is applied. Transformation of variables with values from 0 to 1 to new design variables with values from -∞ to +∞ is performed. Then simple Gauss filtering is applied and reverse transformation to the original variables is fulfilled. The transformation function has the following features: for the "grey values" it is nearly linear, and at -∞ and +∞ it approaches asymptotically to the value 0 and 1, respectively. Variational statement of the problem of finding this transformation function is proposed.

Also, the change of the properties of transformation function allows to control topology layout. This approach is demonstrated on the problems of topology optimization for minimization of structural compliance at a given volume. The advantages of proposed approach and the obtained solutions are discussed.