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TOPOLOGY OPTIMIZATION OF CONTINUUM STRUCTURES USING CONTINUOUS MATERIAL DISTRIBUTION AND MIXED FINITE ELEMENT MODELS

Haitao Ma

Guangzhou University, China
htma@gzhu.edu.cn

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Abstract: This paper presents a study on some of the issues with the conventional SIMP (Solid Isotropic Material with Penalization) model in topology optimization of continuum structures. The approach based on continuous material distributions and mixed finite elements is presented and investigated. By introducing design variables at chosen locations in the design domain, a continuous material pseudo-density can be defined and a smooth boundary can be achieved for the optimized topology. Mixed finite elements are used for the analysis of structures with variable material constants over individual elements. The 2D continuum and plate bending problems are considered and solution algorithms are presented. It is shown that, without the use of any special techniques, the new approach does not suffer from any of the numerical problems with the conventional element design variable and the nodal design variables, such as the checkerboard patterns or islanding phenomenon. Numerical examples are presented to illustrate the advantages of the presented approach and effectiveness of the algorithms.

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