Voigt-Reuss Topology Optimization for Structures with Linear Elastic Material Behaviors

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Abstract

The desired results of variable topology material layout computations are stable and discrete material distributions that optimize the performance of structural systems. To achieve such material layout designs a continuous topology design framework based on hybrid combinations of classical Reuss (compliant) and Voigt (stiff) mixing rules is investigated. To avoid checkerboarding instabilities, the continuous topology optimization formulation is coupled with a novel spatial filtering procedure. The issue of obtaining globally optimal discrete layout designs with the proposed formulation is investigated using a continuation method which gradually transitions from the stiff Voigt formulation to the compliant Reuss formulation. The very good performance of the proposed methods is demonstrated on four structural topology design optimization problems from the literature.

Keywords: topology optimization; structural design; concept design; mixing rules; sensitivity analysis.

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