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论文

多相材料微结构多目标拓扑优化设计

孙士平, 张卫红

西北工业大学现代设计与集成制造技术教育部重点实验室，710072

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摘要 在采用多尺度均匀化方法求解微结构等效特性的基础上，提出了多相材料微结构的多目标优化设计模型. 以组分材料用量为约束，采用周长控制消除棋盘格，结合有限元方法和对偶凸规划求解技术，对两相和三相材料微结构多项等效模量的组合进行了优化设计. 研究比较了微结构网格粗细、材料组分以及三相材料微结构优化中的两相实体材料弹性模量相对比例不同对优化结果的影响. 数值算例验证了优化模型和优化算法的有效性，表明了相关因素对优化结果的影响.

关键词 拓扑优化,微结构设计,多相材料,多目标,均匀化方法

分类号

Multiple Objective Topology Optimal Design of Multiphase Microstructures

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西北工业大学现代设计与集成制造技术教育部重点实验室，710072

Abstract

The overall behavior of an elastic material with a periodic microstructure is governed by the microstructure whose effective properties are computed using a homogenization method. Improvements in materials performance can be obtained by designing new topologies of microstructures of these materials. The topology and volume fraction of the microstructure determines the effective properties of the materials. A multiple objective function model is presented to optimize the topology of the periodic microstructure with two or three-phase materials. A combination of effective elastic properties is maximized. Constraints on material volume fraction and perimeter control for eliminating the checkerboard are considered without the restriction of prescribed microstructure symmetry. By means of finite element method and convex programming techniques, several examples of optimal design of multiphase microstructures are solved. Influences of volume fraction, mesh dependence and elastic modulus ratio of three-phase materials on the optimal microstructures are discussed.
Key words: topology optimization， microstructure design, multiphase materials, Multiple objective function

Key words 拓扑优化,微结构设计 多相材料,多目标,均匀化方法

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通讯作者 shipingsun@163.com