Multi-material Topology Optimization for Continuum Structure by Using Independent Continuous Mapping Method

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Abstract The most significant sense of topological optimization is the ability to find an optimum path transferring load on the base structure to meet particular structural requirements with little material waste. Multi-material topology optimization is to find the best distribution of more than one materials under given loads and constraints, which is an effective means of conceptual design of lightweight structural layout optimization. In this paper, a new topology optimization model for the multi-material continuous structure which aimed at weight minimization and subjected to the structural displacement constraint is established to obtain the lightweight design of multi-material structures. Based on Independent Continuous Mapping (ICM) method, two types of independent topological variables are adopted to realize the interpolations of the element stiffness matrix, element mass matrix and element weight. Furthermore, the structural displacement constraints are approximately expressed as explicit functions with respect to the design variables based on the first-order Taylor expansion. The objective function is standardized based on the second-order Taylor expansion. Therefore, the optimization model is translated into a quadratic program and is solved. The numerical results show that the proposed method for topology optimization of multi-material continuous structures is effective and efficient.

Key words: Independent Continuous Mapping method (ICM method); multiple materials; topology optimization; continuous structure