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Free Material Design

by

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Abstract

The presentation deals with the problem: minimize the convex combination of compliances of an elastic body subjected to non-simultaneous load cases under the condition of the fixed cost of the design. The cost is defined as the integral of the trace of the elastic moduli tensor over the feasible domain. Minimization is taken over all characteristics of the Hooke tensor field within the feasible domain. Locally the Hooke tensor is subject to usual symmetry conditions and to the positive semi-definiteness condition. This problem is usually called: *Free Material Design* (FMD) with the trace constraint. Its origins came back to early 1990's. The present work shows that the problem can be rearranged to the two mutually dual problems closely related to the mass transportation problem. Due to the linear growth of the integrand of an auxiliary minimization problem, the FMD formulation thus constructed makes it possible to solve the problem of *optimal structural topology* or to solve the shape and material optimization in one scheme. The new formulation of the FMD problem paves the way for proving existence theorems, and, depending on the data, the problem of uniqueness of the optimal design.