Topology optimization of spatial continuum structures made of non-homogeneous material of cubic symmetry

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Abstract:
The paper deals with the minimum compliance problem of spatial structures made of a nonhomogeneous elastic material of cubic symmetry. The elastic moduli as well as the trajectories of anisotropy directions are design variables. The isoperimetric condition fixes the value of the cost of the design expressed as the integral of the unit cost assumed as a linear combination of the three elastic moduli of the cubic symmetry. The problem has been reduced to the pair of mutually dual auxiliary problems similar to those known from the theory of materials with locking and from the transshipping theory. The auxiliary minimization problem has the integrand of linear growth, which transforms the problem considered to the topology optimization problem in which simultaneously the shape of the structure and its material characteristics are constructed. In contrast to the free material design which in the single load case leads to the optimal Hooke tensor with a single nonzero eigenvalue, the optimal Hooke tensor of cubic symmetry has either
three or four nonzero eigenvalues.