Isotropic Material Design
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Abstract:
The paper deals with optimal distribution of the bulk and shear moduli minimizing the compliance of an inhomogeneous isotropic elastic 3D body transmitting a given surface loading to a given support. The isoperimetric condition is expressed by the integral of the trace of the Hooke tensor being a linear combination of both moduli. The problem thus formulated is reduced to an auxiliary 3D problem of minimization of a certain stress functional over the stresses being statically admissible. The integrand of the auxiliary functional is a linear combination of the absolute value of the trace and norm of the deviator of the stress field. Thus the integrand is of linear growth. The auxiliary problem is solved numerically by introducing element-wise polynomial approximations of the components of the trial stress fields and imposing satisfaction of the variational equilibrium equations. The under-determinate system of these equations is solved numerically thus reducing the auxiliary problem to an unconstrained problem of nonlinear programming.