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A New Algorithm for the Optimal Design of Anisotropic Materials

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Abstract

A new algorithm for the solution of optimal design problems with control in parametrized coefficients is discussed. The algorithm is based on the sequential convex programming idea, however, in each major iteration a model is established on the basis of the parametrized material tensor. The potentially nonlinear parametrization is then treated on the level of the sub-problem, where, due to block separability of the model, globally optimal solutions can be computed. Although global optimization of non-convex design problems is in general prohibitive, a smart combination of analytic solutions along with standard global optimization techniques leads to a very efficient algorithm for the most relevant material parametrizations. Theoretical properties of the algorithm are discussed. The effectiveness of the algorithm in terms of computation time as well as quality of the solution with respect to global lower bounds is demonstrated by a series of numerical examples. Examples range from free material optimization problems via parametric and discrete material optimization problems (e.g. optimal orientation problems) to two-scale material design.