**Anisotropic material optimization based on topological derivatives**

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**Abstract.** A new material optimization approach is presented. The approach is based on an assymptotic derivative formula allowing the computation of approximately optimal anisotropic material properties of an inclusion inside an isotropic material matrix. The asymptotic formula is a convex function of the linear elastic material tensor by which the material properties inside the inclusion are described. In this paper the derivative formula is interpreted as a model of a given cost function (e.g. compliance or a stress based function) and is used to optimize material properties of finitely many inclusions in a given design domain. Optimization variables are either directly the entries of the material tensors or parameters of nonlinear material laws, which are used to prescribe the symmetry class of the material (e.g. cubic, orthotropic). Hereby, material properties are allowed to vary from inclusion to inclusion. It is shown that in the compliance case globally optimal solutions of the model problem can be obtained. The approximate optimal solutions are validated against a global lower bound for the original problem, computed as a solution of a modified free material optimization problem. We present the basic idea, algorithm details as well as numerical results.

We finally show how the method can be adapted to derive high quality approximate solutions of discrete material optimization problems and how it can be used to compute suitable initial solutions for a class of difficult simultaneous topology and material optimization problems.