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FINITE STRAIN PHASE-FIELD BASED TOPOLOGY OPTIMIZATION

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In this contribution the topology optimization is solved in a finite strain setting using the phase-field regularization. The objective of most topology optimization schemes is the stiffness which for small strains is uniquely defined. For the finite strain situation several definitions for the stiffness exists and in the present contribution the end-displacement will be adopted, i.e. the design that attains the lowest displacement for a given amount of material is searched for.

The mesh sensitivity that topology optimization schemes is suffering from can be removed by the use of filtering teqniques, cf. e.g. [1]. In the phase-field approch, however, the length scale is introduced via a penalization of interfaces beween void and full material. Moreover, in the penalization of gray designs obstacles at the lower and upper bounds are introduced. This feature results in that the problem can formulated as a max/min problem which is solved using the Howard iteration policy scheme, cf. [3].

One of the problems associated with finite strain topology optimization is related to the large deformations of the underlying finite element mesh in regions where the density is close to zero. This problem has been solved by various strategies where for instance residual terms in regions of very low densities are removed from the residual calculation. A recent contribution on the stabilization of low density regions is provided by [2] where a polyconvex strain energy function is used in conjunction with a relaxation scheme.

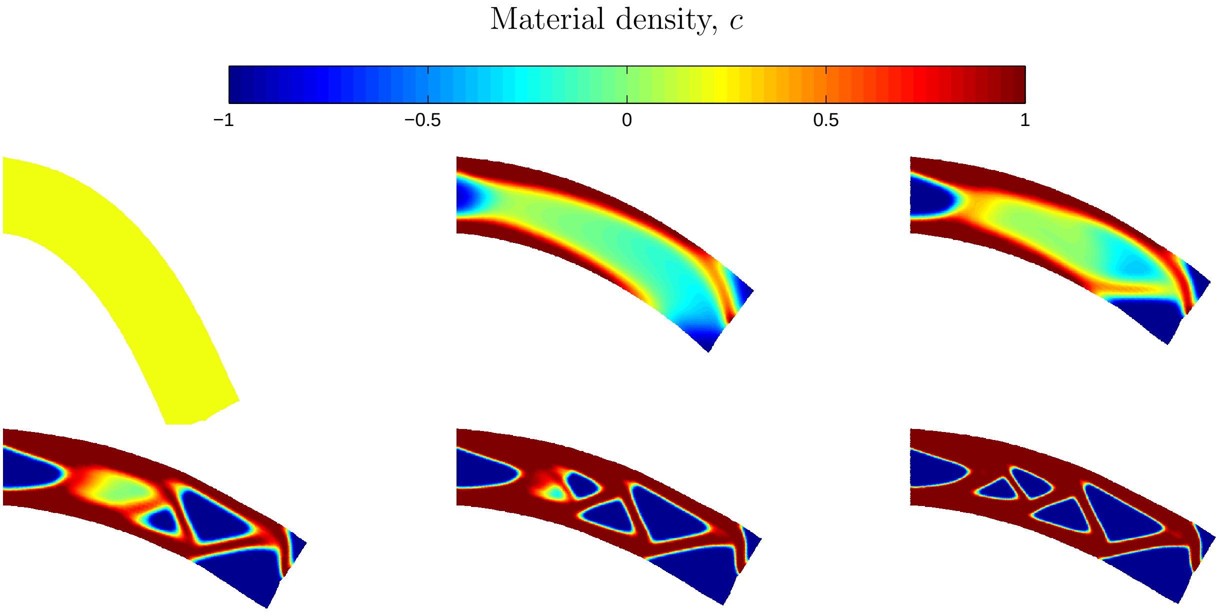

Figure 1: Illustation of the evolution of the design during a finite strain phase-field topology optmimization.

The criterion that defines the optimal state is defined by a second order partial differential equation (PDE) with a similar stucture as the elasticity problem. Both the PDE associated with the elasticity problem and the optimization problem is discretized using the finite element method. To resolve the interfaces between void and full material a the discretization is updated adaptivly. The talk is closed by a numerical example that verifies that the formulation is able to solve the optimization problems for finite strains.

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