27th IFIP TC7 Conference 2015 on System Modelling and Optimization

Recent results on analysis and optimal control of phase field models

A variable metric projection type method for optimal control of phase field models

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Abstract: The reduced problem formulations of optimal control problems of phase field models typically have a non convex cost functional which is only differentiable in a Banach space. Hence gradients do not exist. If an obstacle potential is used in the phase field model, the optimization problem has in addition convex constraints. In the discretized case one can apply the projected gradient method. However, then the iteration number is mesh dependent. We extend this method in function spaces such that no gradient is necessary and generalize the projection to avoid the need of a Hilbert space. Moreover, we allow a variable metric in each step to incorporate second order information as is the case for the Newton-method. We present a global convergence result of the method in Banach spaces.

With computational experiments we demonstrate the independence of the discretization mesh size and of the interface thickness in the number of iterations as well as its efficency in time. We give numerical examples for structural topology optimization problem with linear elasticity equations like the cantilever beam and a compliant mechanism. Here we discuss also the choice of the elasticity tensor on the interface and the influence of the scaling with the interface thickness. Finally, we present results for drag minimization of the Stokes flow, for an inverse problem for a discontinuous diffusion coefficient and for image inpainting.