

Analytical results for a multi-material topology optimization problem for additive manufacturing

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In this talk, a shape and topology optimization problem in a phase field setting is introduced to obtain rigid structures, which are constructable by additive manufacturing methods.

Gravity can deform the structure during construction and therefore damage the final structure. A continuum of linear elasticity equations on growing domains is introduced to model the deformation of unfinished structures, where the stress tensor and gravity can newly depend explicitly on both the current build height h and the spatial variable x . The continuum of problems then motivates the introduction of new Bochner-type function spaces to cope with the degeneration of the domain as $h \rightarrow 0$. In this new setting, existence, Lipschitz continuity and Fréchet differentiability of a control-to-state operator S is shown. Further analytical results for the optimization problem will be given briefly.

Finally, we present some numerical results, where the stress tensor and gravity depend on h and x to model material hardening during construction. Finally the use of external support structures and their influence on the used stress tensor is discussed on an example.