

Exact solutions in optimal design problems for stationary diffusion equation

Krešimir Burazin

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Abstract

We consider multiple state optimal design problems for stationary diffusion in the case of two isotropic phases, aiming to minimize a linear combination of compliances. Commonly, optimal design problems do not have *classical* solutions, so one considers proper relaxations of original problems. A relaxation by the homogenization method consists in introducing generalized materials, which are mixtures of original materials on the micro-scale.

It is well known that for problems with one state equation, there exist relaxed solutions which correspond to simple laminates at each point of the domain. As a consequence, one can write down a simpler relaxation, ending by a convex minimization problem.

For multiple state optimal design problems we derive analogous result in the spherically symmetric case. To be precise, we consider the simpler relaxation and prove that there exists corresponding optimal (relaxed) design which is a radial function, and which is also solution for proper relaxation of original problem. Moreover, we use the necessary and sufficient conditions of optimality to calculate this radial optimal design, and demonstrate the procedure on some examples of optimal design problems, where the presented method enables us to explicitly calculate the solution.