

On global optimization of topology design problems using branch and bound

Mathias Stolpe[‡] Wolfgang Achtziger[§]

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Abstract

In this talk we consider the classical problem of finding a truss design with minimal compliance subject to a given external force and a volume bound. Feasible structures are defined through the ground structure approach. While this problem is well-studied for continuous bar areas, we treat here the case of discrete areas. This problem is of big practical relevance if the truss must be built from pre-produced bars with given areas.

We presents an algorithmic framework for the calculation of a global optimizer of the underlying large-scaled mixed integer design problem. This framework is given by a finitely convergent branch-and-bound algorithm. The method is based on straightforward continuous relaxations of the integer requirements posed on the bar areas. The relaxed nonlinear optimization problem can be reformulated as a quadratic programming problem. Although the Hessian of this quadratic program is indefinite, it is possible to circumvent the non-convexity and to calculate global optimizers. Moreover, the quadratic programs to be solved in the branch-and-bound method differ from each other just in the objective function. Therefore, very good starting points are available at each node of the search tree. This makes the branch-and-bound methodology efficient. The presentation closes with several large-scale numerical examples.

Keywords: truss topology optimization, global optimization, branch-and-bound

[‡]Department of Mathematics, Technical University of Denmark, Matematiktorvet Building 303, 2800 Kgs. Lyngby, Denmark. E-mail: m.stolpe@mat.dtu.dk

[§]Institute of Applied Mathematics, University of Dortmund, FB Mathematics, LS X, 44221 Dortmund, Germany. E-mail: wolfgang.achtziger@uni-dortmund.de