
Greg von Winckel
**Reduced and Full Space Methods in Topology
Optimization: Applications in Linear Elasticity and
Electrical Conduction**

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Topology optimization is a method which aims to compute a spatial distribution of materials to optimize a design figure of merit. A standard such problem appears in the design of truss structures where the physics are linear elasticity and the intention is to optimize load compliance. We also consider the problem of designing electrical conduits in a two port network with topology optimization. While this appears to be a straightforward problem, it presents challenges due to an effective lack of uniqueness of the solution arising from extreme differences in conductivity in the structure. A regularization method to obtain physically desirable solutions is introduced.

Commonly topology optimization problems are solved using mesh-dependent approaches such as the Method of Moving Asymptotes which addresses the problem of the inherently concave objective functions by making a sequence of convex approximations. With large scale optimization problems constrained by complex partial differential equations, more standard optimization approaches such as SQP and interior point methods have been demonstrated to have superior convergence properties[1].

In this work we explore solution of elasticity and conductive network topology optimization problems in the full space setting with an interior point method using successively penalized SQP solves and a reduced space method using trust region methods with bound constraints. The optimization is carried out using the Rapid Optimization Library (ROL), a modular C++ package that is part of the Trilinos suite of scientific computing tools. Solution of general inequality constrained problems and implementation of efficient preconditioners is an area of active development within ROL.

[1] Susana Rojas-Labanda and Mathias Stolpe, Benchmarking optimization

solvers for structural topology optimization, Struct. Multidisc. Optim. (2015)
52:527547