8th. World Congress on Computational Mechanics (WCCM8)
5th European Congress on Computational Methods in Applied Sciences and Engineeering (ECCOMAS 2008)
June 30 –July 5, 2008
Venice, Italy

TOPOLOGY OPTIMIZATION OF LINEAR ELASTIC STRUCTURES WITH CONTACT BOUNDARIES

*** N. Strömberg**[1]

[1] Jönköping University
Department of Mechanical Engineering
P.O. Box 1026, 551 11 Jönköping, Sweden
stni@jth.hj.se, `http://home.hj.se/~stni/stni.html`

Key Words: *Contact mechanics, Topology optimization, Newton's method, Sequential programming.*

ABSTRACT

A method for topology optimization of linear elastic structures unilaterally constrained to rigid supports is suggested. The supports are modeled by Signorini's contact conditions which in turn are treated by the augmented Lagrangian approach. The state of our system, which is defined by the equilibrium equations and the contact laws, is solved by a non-smooth Newton method. The design parametrization is obtained by using the SIMP-model (Solid Isotropic Material with Penalization). The minimization of compliance for a limited value of volume is considered. The optimization problem is solved by a nested approach where the equilibrium equations are linearized at a given state. The problem is then solved by SLP (Sequential Linear Programming).

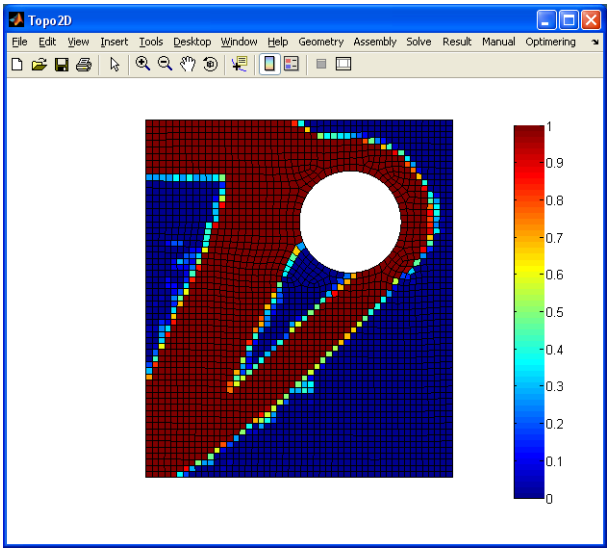

Figure 1: *Optimal solution for an elastic structure unilaterally constrained to a rigid pin.*

The method is implemented in Topo2D. Topo2D is a Matlab toolbox for topology optimization under development. The implementation is done for a general design domain by using fully integrated isoparametric elements. The code is written in Matlab and Visual Fortran, where the Fortran code is linked to Matlab as mex-files. The sparsity is utilized. In particular the implementation of the filter of Sigmund also utilize the sparsity and it is most efficient. The LP-problem is solved by using the interior point method which can be found in the optimization toolbox of Matlab. The implementation seems to be very efficient and robust. A first version of the toolbox can be downloaded at `http://home.hj.se/~stni/MATERIALS/TOPO2D.zip`. The example shown in Figure 1 is included in the package. This figure shows the optimal solution for an elastic structure unilaterally constrained to a rigid pin. The number of elements is 2621. The convergence in compliance is shown in Figure 2. The CPU-time on a 1.79 GHz processor is 356 s. The example is easily loaded and executed from the GUI and the post process is also straight-forward. This will be demonstrated at the conference.

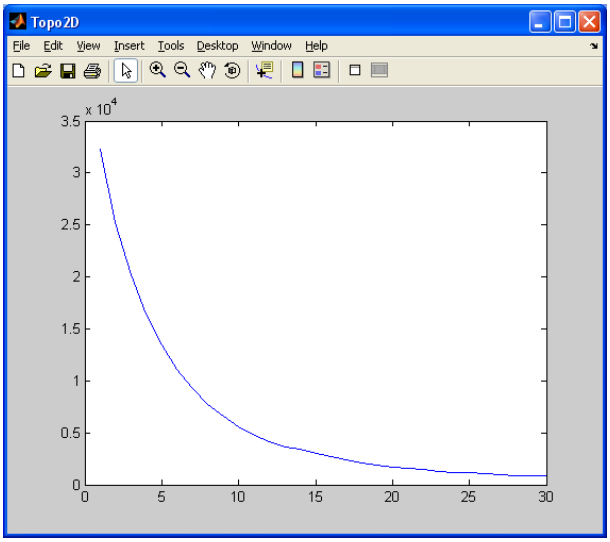

Figure 2: *Convergence in compliance.*

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