

TOPOLOGY OPTIMIZATION AND DESIGN ROBUSTNESS

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Abstract

If no countermeasures are taken during optimization, topology optimized structures most likely become vulnerable to load and geometry perturbations. A straightforward remedy for the former is to take multiple load cases into account. For the latter, so-called robust formulations, that ensure robustness to erosion/dilation (over-/under-etching) in worst-case approaches [1] or random geometry variations by Monte-Carlo sampling [2], ensure insensitivity to certain manufacturing variations. Both approaches are expensive and require multiple additional and expensive analyses for representation of the uncertainties.

A number of older and recent perturbation approaches, and other more efficient ways for treating uncertainties (like stochastic gradient approaches [3]) are showing promises for providing more efficient ways of performing topology optimization taking uncertainties into account but have so far been suffering from various challenges.

The talk gives an overview of the state of the art and presents a new efficient approach for ensuring robust structures insensitive to geometry variations, that only requires two additional adjoint analyses and is shown to converge with mesh-refinement. The new approach applies to, and will be demonstrated on, several challenging problems within structural and multidisciplinary topology optimization

References

- [1] F. Wang, B.S. Lazarov, and O. Sigmund. On projection methods, convergence and robust formulations in topology optimization. *Structural and Multidisciplinary Optimization*, 43(6):767–784, 2011.
- [2] M. Schevenels, B.S Lazarov, and O. Sigmund. Robust topology optimization accounting for spatially varying manufacturing errors. *Computer Methods in Applied Mechanics and Engineering*, 200(49-52):3613–3627, 2011.
- [3] A. Uihlein, O. Sigmund, and M. Stingl. A 140 line Matlab code for topology optimization problems with probabilistic parameters. *Structural and Multidisciplinary Optimization*, 69(7), 2026.