10th World Congress on Structural and Multidisciplinary Optimization May 19-24, 2013, Florida, USA

Combining the best of both worlds - shape optimization using a combination of homogenization and sensitivity based method

Peter M. Clausen
FE-DESIGN GmbH, Haid-und-Neu Strasse 7, D-76131 Karlsruhe, Germany
peter.clausen@fe-design.de, +49 721 96467 236

Keywords: Shape optimization, industrial applications, large scale optimization

Abstract

The current paper describes a new method of combining sensitivity based shape optimization [1] with a homogenization method, the controller based method [2].

The sensitivity or gradient based method is a classical mathematical approach which uses at least the first derivative of functions to minimize, maximize or constrain certain structural responses. The controller based method is a gradient-less homogenization method that uses the physics of a large class of structural problems where increasing material in highly stressed areas and decreasing material in other areas leads to a homogeneous stress distribution.

The combination of the two methods is rooted in the assumption that the sensitivity of an objective function can be approximated with the controller methods nodal values. This combines the best of both worlds and opens up the possibility to solve a large amount of problems, which for different reasons could not be realized within the single framework of either the sensitivity or homogenization approach. The new method is implemented in an industrial framework and an example from an automotive application is shown. The shape optimization is non-parametric in the sense that no CAD parameters are used. Instead, the nodal positions are the shape changing design variables.

References

[1] K. K. Choi and N.-H. Kim. *Structural Sensitivity Analysis and Optimization 1 - Linear Systems*. Springer, 2005.

[2] R. Meske, J. Sauter, and E. Schnack. Nonparametric gradient-less shape optimization for real-world applications. *Structural and Multidisciplinary Optimization*, 30:201–218, 2005. 10.1007/s00158-005-0518-0.