EngOpt2018 - 6th International Conference on Engineering Optimization
Instituto Superior Técnico, Lisbon Portugal • 17-19 September, 2018
Editors: H.C. Rodrigues, J. Herskovits, C.M. Mota Soares, et al.

Abstract ID 1002

A GENERALIZED SNC-BESO METHOD FOR MULTI-OBJECTIVE TOPOLOGY OPTIMIZATION

David Munk[(1)], Timoleon Kipouros[(2)], Gareth Vio[(1)]

[(1)]The University of Sydney, Australia
david.munk@sydney.edu.au, gareth.vio@sydney.edu.au

[(2)]University of Cambridge, United Kingdom
tk291@eng.cam.ac.uk

Keywords: Smart Normal Constraints; Topology optimization; Multi-objectives

Abstract: Multi-objective optimization plays a vital role in any engineering design problem. Ultimately, a designer must make a trade-off between contrasting and conflicting design objectives. The current approach to facilitate this trade-off is to solve an optimization problem, which yields a candidate solution. This optimization problem usually entails the minimization of a given objective function subjected to a number of constraints. Topology optimization has become a highly developed tool for solving optimization problems, extensively used in the mechanical, automotive and aerospace industries (Sigmund (2011)). Furthermore, gradient-based topology optimization has been proven to efficiently solve fine-resolution problems, having thousands or even millions of design variables, with only a few hundred function evaluations. However, the literature of topology optimization shows a lack of multi-objective algorithms, limiting their application to single objective problems. Recently, Munk et al (2017) introduced the smart normal constraints bi-directional evolutionary structural optimization (SNC-BESO) method, showing that the method is able to produce smart Pareto sets in an effective and efficient manner. However, the method is restricted to bi-objective optimization problems and cannot yet handle multiple constraints. Therefore, if the method is to be successful, the generated Pareto set must truly be representative of the complete optimal design space. Hence, the Pareto set must not over represent one region of the design space, or neglect other regions. This study offers a new development in the SNC-BESO method, which is a simple method for generating smart Pareto solutions that are evenly distributed in the design space. An even distribution of Pareto solutions facilitates the task of choosing the most desirable final design from the set of smart Pareto solutions. The developments presented in this work are namely the ability to generate a set of evenly distributed Pareto solutions over the complete Pareto frontier for multi-objective problems with any number of objectives. Examples will be provided that show the SNC-BESO method applied to n-objective problems, showing its ability to capture all regions of the feasible design space. Therefore, generalizing the SNC-BESO method to all types of multi-objective topology optimization problems.

References

(1) Sigmund O. (2011) On the usefulness of non-gradient approaches in topology optimization, Struct Multidiscip Optim 43, 589-596.
(2) Munk D.J., Kipouros T., Vio G.A., Parks G.T. and Steven G.P. (2017) Multiobjective and multi-physics topology optimization using an updated smart normal constraint bi-directional evolutionary structural optimization method, Struct Multidiscip Optim https://doi.org/10.1007/s00158-017-1781-6.