Date January 12th 2015
Contact Matthijs Langelaar, Alejandro M. Aragón
Address Gebouw 34, Kamers G-1-300 and G-1-380
Mekelweg 2, 2628 CD Delft
Telephone 015-278 6506, 015-278 2267
E-mail M.Langelaar@tudelft.nl, A.M.Aragon@tudelft.nl

Feasibility of new FE formulations within topology optimization

Master of Science project

Abstract

The M.Sc. project aims at studying different finite element formulations to solve checkerboard patters in optimized designs, a long-standing problem in topology optimization. The candidate will review different finite element formulations and proceed to their implementation in *Hybrida*, a new finite element package being developed within the Structural Optimization and Mechanics (SOM) group.

Introduction Topology optimization is a computational approach by which a system or structure is optimized with respect to a given objective function. It is a very active area of research for its tight ties with the industry. This project aims at investigating the checkerboard problem, an issue that arises in topology optimization due to the use of low order finite element (FE) interpolations. Figure 1 shows a beam that is being optimized and a resulting design that shows this checkerboard pattern. The candidate will investigate alternative FE formulations that could be used to solve this longstanding problem.

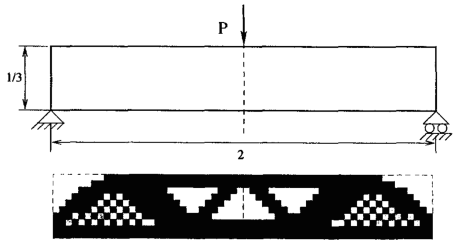

Figure 1: Design problem and checkerboard pattern, taken from [1]

Tasks *i)* Conduct a thorough literature review on the different finite element methodologies that are used within topology optimization and survey those that have a checkerboard problem. *ii)* Investigate new formulations, some of which will be proposed by the advisors. *iii)* Proceed to the implementation of the new formulations within *Hybrida*, a new finite element library that is being developed within the Structural Optimization and Mechanics (SOM) group. *iv)* Test if the new formulations solve the checkerboard problem, and provide a thorough analysis about under which conditions this is possible. *v)* The conceptualization of more challenging problems. *vi)* Presentation of results and the preparation of a report that could potentially lead to a peer-reviewed journal publication.

Requirements The student should have modeling experience and basic knowledge of finite element analysis. Knowledge of topology optimization is a plus, and programming experience with the Python language is recommended.

References

[1] O. Sigmund and J. Petersson. Numerical instabilities in topology optimization: A survey on procedures dealing with checkerboards, mesh-dependencies and local minima. *Structural optimization*, 16(1):68–75, 1998.