6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11-15 June 2018, Glasgow, UK

A Study on Lattices in 3D Compliance Minimization and Validation of Interpreted Optimization Results

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Keywords: *Two-scale Optimization, Homogenization, Additive Manufacturing*

We consider a two-scale material optimization approach in linear elasticity using homogenized base cells as introduced by Bendsøe and Kikuchi in [1].

In the context of lattice structure optimization for additive manufacturing, we discuss the practicability of different base or unit cells and choose orthotropic base cells, which are stiffness optimized with separate parametrization for the horizontal, vertical and lateral direction. We study the applicableness of lattices for compliance minimization under different loading scenarios, such as external pressure or bending loads. Our examples are based on components inspired by the aircraft industry. Furthermore, the impact of lattice orientation inside the component on the performance and manufacturing bounds is being elaborated.

Along with this study, we present the full workflow from two-scale optimization towards printing by additive manufacturing technologies. This encompasses the generation of parametrized base cells for optimization, the interpretation of optimized results, as a macroscopic lattice design including solid and void non-design regions, and the generation of a ready-to-print surface description of the lattice structure. Followed by a numerical validation of the interpreted design.

REFERENCES

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