International Congress Engineering of Advanced Materials ICEAM2017
10 - 12 October 2017
Erlangen, Germany

New multiscale approaches in topology optimization

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Keywords: Structural optimization, topology optimization, multiscale methods

Fired by recent progresses in additive manufacturing techniques, multiscale topology optimization approaches have recently received intense interest and many efficient and interesting approaches have been presented.

Common challenges of multiscale schemes include lack in separation of scales, tiling of locally optimized microstructures and manufacturability. This paper discusses various new approaches to overcome these challenges performed within the TopOpt group (www.topopt.dtu.dk) at the Technical University of Denmark.

In one approach we revisit the original homogenization-based topology optimization schemes and suggest a simple graphical projection scheme that realizes fine-grained optimal structures from coarse-scale homogenization solutions [1]. The scheme includes length-scale constraints on solid and void features. Further, we demonstrate how the same scheme can be used to provide high quality starting guesses for truss and frame optimization with large numbers of elements.

In another approach we introduce a local volume constraint to provide porous and optimized infill structures for closed-walled 2d and 3d structures realized by additive manufacturing technologies [2]. By adding advanced projection schemes we allow variable outer shape to be included in the design process as well. The structures provide two-scale designs without the requirement of separation of scales.

References

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