Extremely large-scale topology optimization

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Abstract

The development of high performance computing resources and scalable software libraries enable the use of increasingly higher resolution in topology optimization problems. It is now possible to solve three-dimensional problems with a resolution of 100 of millions finite elements using computing clusters [1].

This work presents several examples of large-scale topology optimization. The discussion focuses on the added insight provided by the very fine resolution of the optimization domain made possible by the recent developments of computational resources and scalable code. This goes hand-in-hand with the increasingly popularity of additive manufacturing (AM), because it is now possible to discretise the domain down to the manufacturing precision of most AM machines.

The same code can be used to solve smaller, but still decent sized, topology optimization problems with more than a million finite elements on a desktop computer within a reasonable amount of time. Finally, a comparison with prior large-scale structural optimization is presented.

[1] N. Aage, E. Andreassen, B. S. Lazarov, Topology optimization using PETSc: An easy-to-use, fully parallel, open source topology optimization framework, Structural and Multidisciplinary Optimization, 1-8, 2014 (available online).