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ADVANCES IN HOMOGENIZATION-BASED TOPOLOGY OPTIMIZATION FOR HIGH-RESOLUTION MICROSTRUCTURES

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Abstract: The objective of this work is to present recent advances in projection methods to obtain high-resolution manufacturable structures from efficient and coarse-scale, homogenization-based topology optimization results [1,2]. The focus of this work is on compliance minimization of linear-elasticity problems, for which it is known that the optimal solution is in the space of layered materials. In a very appealing approach Pantz and Trabelsi introduced a method to project the rank-2 microstructures from homogenization-based topology optimization, to obtain a solid-void design with finite length-scale [3]. The microstructures are oriented along the directions of lamination such that a well-connected design is achieved. This approach paves the way for coarse-scale topology optimization where the projection can be performed on a high-resolution mesh, without a need for cumbersome and expensive multi-scale formulations. In a recent work we have simplified the projection procedure, and introduced procedures for controlling the shape of the projected design [1]. This allowed for high-resolution (~1 million elements in 2D), near-optimal and manufacturable designs, obtained within a few minutes on a standard PC. In the current work we will demonstrate extensions of the method into three dimensions, and discuss the potential of the method over standard topology optimization methods. Especially, with regard to the large savings in computational cost. Furthermore, the application of the method in the context of infill design for coated structures will be discussed.

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