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New algorithms for considering manufacturing constraints in topology optimization

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Abstract

The issue of imposing manufacturing restrictions in topology optimization is an important but challenging task. Solutions must not only be realizable, but ideally have also accounted for the manufacturing process within the design process, minimizing (or eliminating) post-processing needs that may be time consuming and degrade optimality. While many such restrictions can be imposed via a series of geometric, search-based constraints, such approaches are typically computationally inefficient and are sensitive to parameterization used to implement the constraints in the optimization algorithm. An alternative to such approaches is to embed the restriction in the design variable definition, such that solutions automatically satisfy these restrictions without explicit constraints. This, for example, is the idea behind projection methods for imposing minimum length scale, among other process constraints. This paper presents several new algorithms for imposing manufacturing constraints, including new algorithms for simultaneously imposing minimum and maximum length scale on features and/or holes, imposing casting constraints, and for designing materials manufactured via photopolymer waveguides. All algorithms follow the material distribution approach to topology optimization, are solved using the Method of Moving Asymptotes, and are tested on benchmark problems.