Topology Optimization for Additive Manufacturing with distortion constraints

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ABSTRACT

The switch to Additive Manufacturing for producing a part involves more than just a superficial adaption of the traditional design. Designers and engineers need to deviate from their routines and learn how to optimally deal with the freedom that is suddenly granted to them. When talking about design for Additive Manufacturing, Topology Optimization and Additive Manufacturing seem like a perfect match. Topology Optimization complements the unlimited form freedom provided by Additive Manufacturing by allowing unlimited design freedom.
One of the problems encountered during and after production of a part by Additive Manufacturing is excessive deformation due to uneven thermal shrinkage. During production this may lead to wiper blade (recoater) collision, after production the part may not stay within required shape tolerances.
In this contribution we present a method to extend Topology Optimization with additional constraints to prevent failure due to distortion. First a finite element model is derived for analysis of distortion due to thermal shrinkage. Next the constraints are formulated to prevent wiper blade collision and excessive distortion after release from the build plate. Their sensitivities are derived by the adjoint method and the constraints are applied to a Topology Optimization routine.
Some examples will be presented to show the influence of the applied constraints on the final designs.