

Product And Process Optimization For Additive Manufacturing

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Numerical analyses are commonly used to verify product designs subjected to service loads, while the making of the part itself is rarely accounted for. With additive manufacturing, the process of creating parts receives increased attention as the part production process can no longer be ignored. These new production technologies can introduce novel design perspectives, allowing for design solutions, which were laborious or impossible to achieve with traditional methods. Yet, the process of printing a part can impose other, sometimes-unexpected constraints on a design.

Just like a designer's view must widen to incorporate additive manufacturing processes, design verification with numerical methods must be expanded to include the part history; and likewise product optimization must evolve into product and process optimization. Printing a part can be a complex, time-consuming, and costly task and a design, which may be pleasing on the drawing board, may show design flaws and possible failure later on in the printing process

This presentation demonstrates how an optimization driven design process, which includes the part manufacturing process, can enable the product designer to obtain a design solution, which is actually suitable for a print process.

A water-cooled nozzle is considered for product optimization with respect to the manufacturing process. The initial design is adapted for the print process, and then further optimization steps are performed to find the best shape and placement of the interior cooling channels. In the process loop, the printability of each design variant is verified by simulating the print process. Original CAD data and full-scale realistic models are combined with multi-disciplinary optimization to analyse the structure subjected to thermal and mechanical loads.

Considering the time and cost of 3D-printing, this combination of numerical techniques can help to avoid costly trial and error design by eliminating infeasible design solutions well before starting the printer.