Lattice topology optimization and 3D printing of a 316L control arm

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ABSTRACT

Topology optimization (TO) and Additive manufacturing (AM) techniques are nowadays mature enough to be used in industry [1]. The combination of both disciplines opens the door to produce novel and disruptive designs that are not possible to create with traditional manufacturing processes.

More specifically, Lattice Topology Optimization (LTO) is best suited than traditional TO when AM is used, enabling a faster process from design towards manufacturing [2]. This is mainly due to that LTO output directly relates to the shape to be manufactured, meaning that it does not require (or very limited) design interpretation of the optimum results. Moreover, the increased performance of a LTO design over a TO design where manufacturing constraints are taken into account supports the choice of LTO.

This paper proposes a methodology (left part of Figure 1) that covers all the steps in the design of a new lattice optimized component that is intended to be produced using additive manufacturing. It starts with a LTO, and afterwards the results are converted into ”lattice printable information” using dedicated software. Finally, this information is refined and prepared to be sent to the 3D printer.

The methodology is tested with a case example of an automotive control arm. The goal of the optimization is to reduce the mass, while fulfilling a number of displacement constraints. Sensitivity studies have been carried out in order to evaluate the influence of the upper and lower bounds of lattice existence in the performance of the designs. Moreover, the optimal designs obtained from LTO have been compared against TO with and without manufacturing constraints. The results (right part of Figure 1) prove that the performance of LTO is higher than TO if manufacturing constraints are considered. Finally one of the LTO designs is 3D printed using 316L stainless steel.

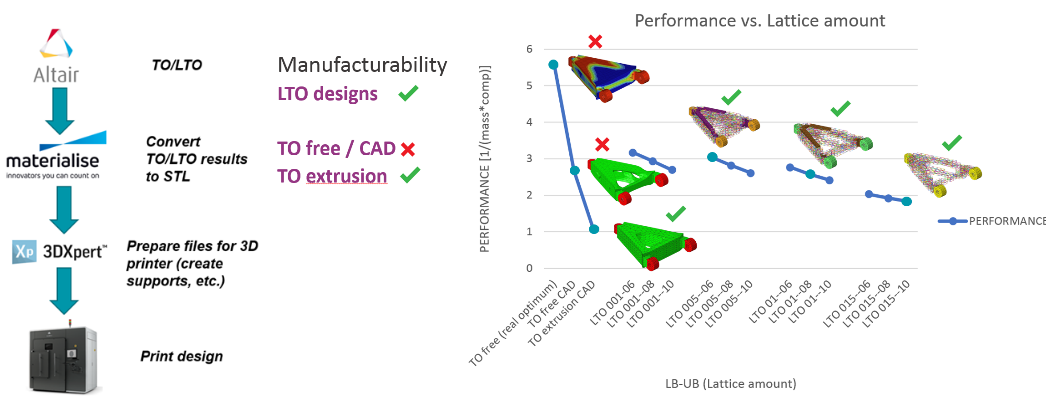

Figure 1: Flowchart of steps (left) and Summary results of TO and LTO (right)

REFERENCES

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[2] Tang, Y., Dong, G., Zhou, Q., and Zhao, Y.F., Lattice Structure Design and Optimization With Additive Manufacturing Constraints. *IEEE Transactions on Automation Science and Engineering* (2018) **15(4)**:1546-1562