Design of Automotive Components for Additive Manufacturing exploiting Topology Optimization

Giuseppe Giovanni Maria Crisafi*, Effretti Fabio†, Mauro Olivero*, Giulia Servoli*

* Centro Ricerche Fiat S.C.p.A.
Product Development, Global Innovation – Trento Branch
via Sommarive, 18 - 38123 Trento, Italy
e-mail: giulia.servoli@crf.it, web page: https://www.crf.it

† Graduate student at Politecnico di Torino
Corso Duca degli Abruzzi, 24 - 10129 Torino, Italy

ABSTRACT

Additive Manufacturing (AM) is on the rise in automotive applications because of the freedom to manufacture complex designs at reasonable costs, the possibility to maximize the weight saving and to shorten the time to market.

The case study involves redesign of two automotive chassis components with topology optimization: a lower control arm and a front knuckle. In this article we focus on reaching mechanical requirements in order to obtain a design that satisfies the structural performances with a reduction in weight with reference to actual production component.

The optimization is run considering different type of loading: fatigue, misuse and stiffness. Weight compliance approach is used to determine the optimum layout across the loading conditions.

As reported in Figure 1a workflow is followed to redesign the parts. The first step is the definition of the design space. Next, topology optimization is performed by assign different loads and boundary conditions. Then finite element analysis is used to evaluate the structural performances of the obtained lightweight design after a loop with CAD modelling.

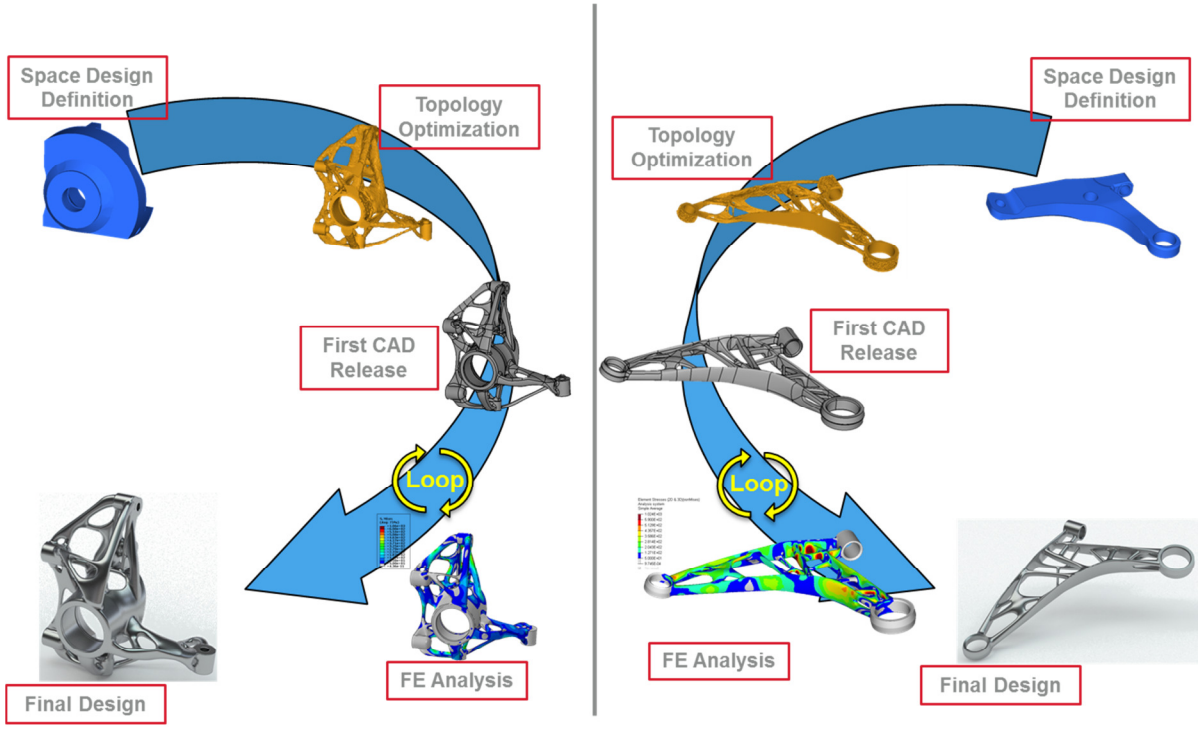

Figure 1 Workflow for redesign the parts

Finally, a virtual validation on semi-rigid suspension model is done to define the final design of both components, achieving a weight reduction of about 15%.