CASE STUDY

HyperWorks Structural Optimization Reduces Suspension Design Time at Alfa Romeo

Overview

Using Altair HyperWorks, Italy-based Alfa Romeo was able to significantly reduce design time by integrating multibody dynamics (MBD) with structural optimization. The resultant suspension design showed superior performance characteristics.

Business Profile

Alfa Romeo, a part of FIAT SpA/Italy, is a leading manufacturer of sports cars. The company is recognized for style, sportiness and vitality, while Its automotive technology is geared towards performance, driving pleasure and driving control.

Challenge

Alfa Romeo needed to develop an innovative suspension design for a new concept car. In order to achieve superior vehicle handling performance, a double-wishbone suspension concept was chosen (Fig. 1). This layout is generally less comfortable than other suspension systems, but provides superior handling capabilities and is therefore preferred in sport cars. Timing was a critical factor, so Alfa Romeo utilized an integrated multibody-topology optimization approach to quickly come up with the best solution.

Benefits:

- ***Reduction of time to market*** *by identifying potential issues early*
- ***Reduction of physical prototypes*** *because physical behavior can be investigated virtually*
- ***Increase in product quality*** *by allowing a greater number of design iterations*

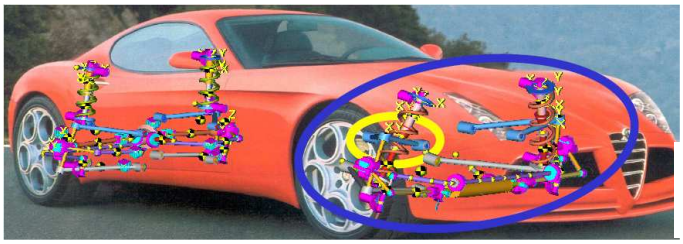

Figure 1.
MBD model of a front and rear suspension system

Solution

The project consisted of two optimization steps:

1. Optimization of the system kinematics to bring the suspension performance within target range.
2. Topology optimization of the suspension components to achieve the best design with minimum mass.

Step One was performed using Altair HyperStudy, a HyperWorks software tool, to optimize the suspension kinematic points. According to engineers, the optimized attachment points showed innovative positioning of the control arms. Results from Step One (the resultant design space and connection points) where taken as input for Step Two: structural optimization of the suspension components, including the upper and lower control arm, steering and the stabilizer bar.

In Step Two, the best material distribution for a component within a verified design space was defined. It was necessary to meet certain mass and stiffness targets. Based on OptiStruct results, Alfa Romeo engineers created a first design of the control arm. The process is illustrated in the example of the upper control arm below (Fig. 2).

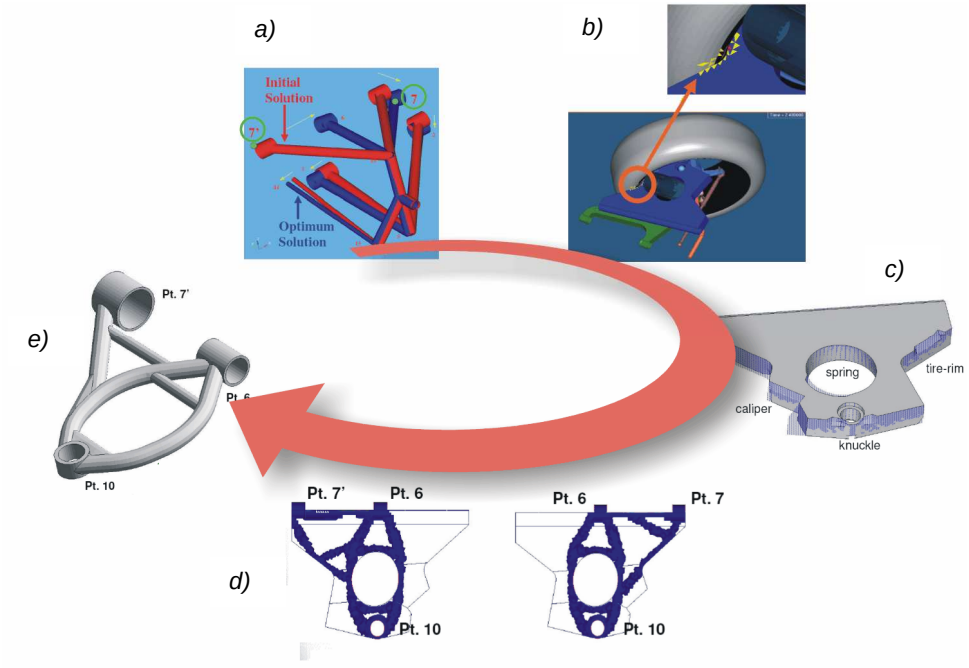

Fig 2: The integrated MBD structural optimization process.

- *a) Kinematics optimization*
- *b) Design space definition*
- *c) Modified design space from packaging analysis*
- *d) OptiStruct design proposal*
- *e) Optimized design concept*

Results

The integrated optimization process resulted in substantial time savings to develop a quality prototype. In addition, the method enabled engineers to reach the comfort and handling characteristics of an Alfa Romeo sports car. Moreover, physical tests highlighted an impressive correlation with the virtual models.