Application of ANSA optimization tools to automotive HVAC system

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Introduction
Optimization process plays a central role in industrial design, even more in automotive. In this work an optimization procedure will be applied to improve Ferrari GTC4Lusso HVAC system performances, reducing total-pressure loss.

Objectives
Applying the total-pressure drop of the ideal duct, which is the result of an optimization procedure with the only constraints of inlet and outlet interfaces and manufacturing. Unfortunately, the theoretical conduit cannot cope with the surrounding parts of the car.

Results
In a week of computational time, the procedure generates many improved designs. Among them, the configuration with the highest total-pressure drop reduction, complying with space requirements, shows a \( \Delta P_{\text{tot}} = 12.4 \text{ Pa} \) and an increased flow uniformity index to 0.914.

Methodology
A random optimization task is set up in ANSA\(^\circ\), in which more than 1000 new configurations are generated, as shown in the next diagram.

13 morphing parameters drive the duct wall displacements, which have to necessarily agree with the dimensions of the surrounding parts.

Conclusions
Complicated geometry, such as the object of this procedure, showing three different cross section shapes, asymmetric area decrease, elbows etc., requires many parameters to be accurately described, using a CAD parametric optimization procedure. ANSA\(^\circ\) morphing tools overcome this problem by easing shape variations. A significant number of morphing parameters is needed to perform an efficient mesh modification, while avoiding issues related to excessive mesh deformation. The procedure developed is suitable for aerodynamics optimization, not only for automotive, but also for other range of applications.

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