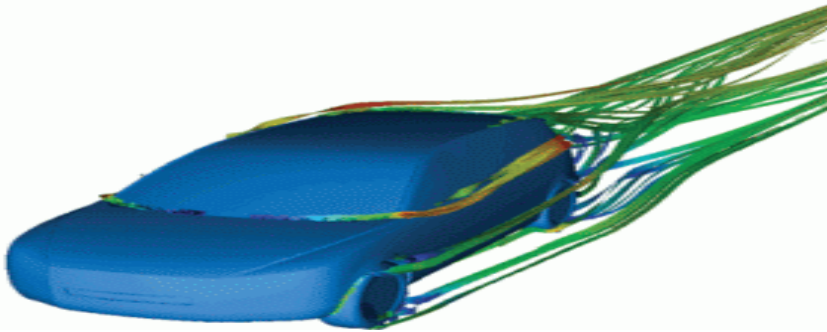


Decreasing optimization time with Sculptor™: **overview**



TIME: 40 Hours

TOOLS: AVL Fire
modeFRONTIER
Sculptor

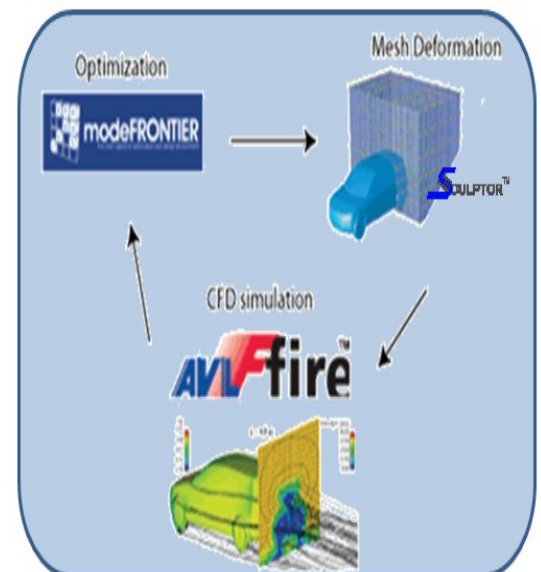
What are the Goals?

The project described here aims at creating an automated shape optimization process, able to optimize any geometry with respect to aerodynamic properties. Since the rear end of any personal car is responsible for most of the aerodynamic drag, the choice was to focus the shape modifications on such a region, while keeping the rest at the previously defined frozen-design stage. In this case, the optimization is performed on the rear end of a simplified full size car model from Volvo Cars Corporation.

So What?

To tackle such a challenge within a timeframe compatible with the ever accelerating development pace of the automotive industrial standards and environmental requirements, all the phases of this process should take advantage of the best-in-class technologies.

Hence, the software used is modeFRONTIER for the “process integration” and “design optimization” part, Sculptor for mesh morphing and AVL FIRE for initial mesh creation and CFD calculations. One need is to limit the number of considered independent parameters controlling the shape. They should be as few as possible, to speed up the optimization search. On the other hand, they should be able to generate the widest set of shapes to be explored. Sculptor’s mesh deformation technology makes the difference compared to a traditional parametric CAD approach, allowing to control the key shape-features of the vehicle’s rear end with only two parameters.



Decreasing optimization time with Sculptor™: details

Re-Cad

Re-Mesh

CFD
Pre

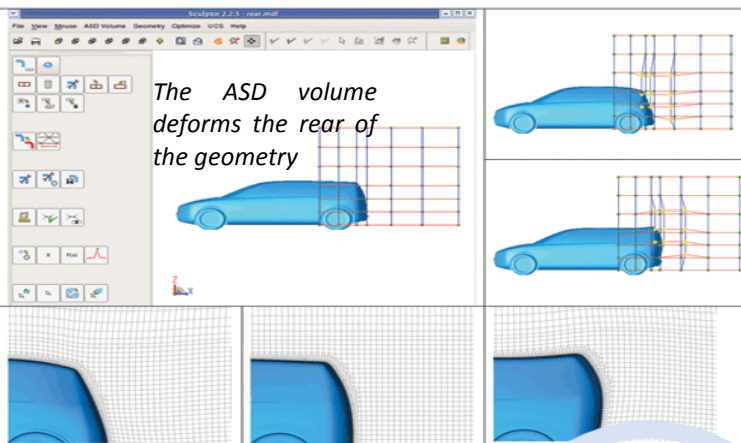
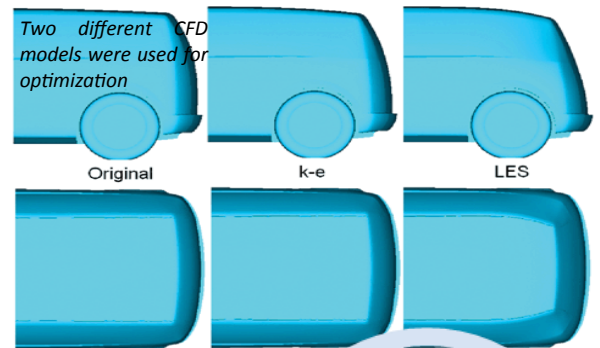
Mesh
Morph

90 % time saving with Sculptor™

Time advantage in creating any new configuration after the initial one.
**Exports to CFD

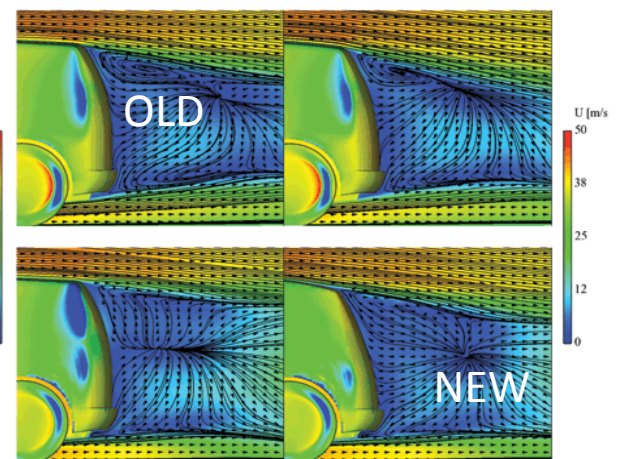
Sculptor™ enables the user to easily parameterize a complex model while respecting element quality constraints. It also removes the re-CAD, re-mesh and pre-process operations for each new design iteration, by modifying the shape of the CFD model directly. Once the improved design was found, it allowed the transfer of the deformations to the original CAD model directly.

The surface of the vehicle needed to be shaped with two distinct parameters. The rear of the vehicle had to be designed so that its aerodynamic design would generate low drag force with the needed down force. These two objectives combined will increase the fuel efficiency of the vehicle. Incorporating Sculptor as part of an optimization loop, decrease the

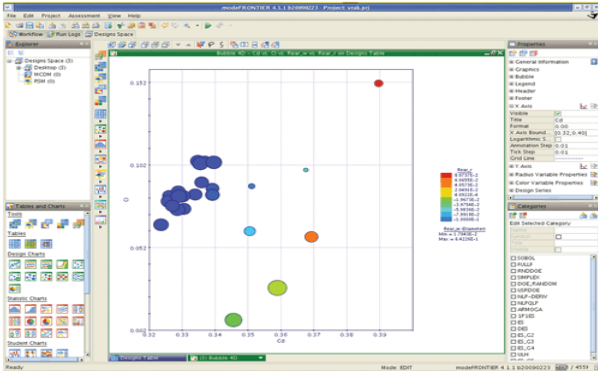


Sculptor™'s morphing technology was applied over a Computational Fluid Dynamic (CFD) model of the vehicle, to define its optimal external skin surface. The original mesh was read into Sculptor™, and the model was prepared for morphing.

Using Arbitrary Shape Deformation (ASD) volumes, different configurations were instantly tested, without the need of re-creating the mesh. By moving the control points, new configurations were created immediately and then submitted to CFD. Finally, the configuration giving the best results was chosen.



AVL, Sculptor™ and modeFRONTIER: faster and cheaper design



Results

Speeding up the optimization by using high-efficiency and parallel Optimizers such as modeFRONTIER's Evolution Strategies. When the optimal design has been obtained, re-creating the optimal CAD geometry is simple: the Sculptor deformation tool can deform the original CAD geometry in the same way as the mesh.

Conclusions

modeFRONTIER is able, through its "workflow", to link and manage the Sculptor mesh-deformation software and the CFD solver AVL FIRE. Sculptor itself, thanks to its mesh deformation technology, allows to keep CAD and mesh generator software out of the optimization loop, sparing time and resources. In the same moment, it allowed to control the shape of the vehicle model with only two parameters.

Thanks to the efficiency of the modeFRONTIER "Evolutionary Strategy" algorithm and its parallel nature, it has been possible to complete the optimization in an acceptable timeframe even using high accuracy physical models.

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About Sculptor™

Sculptor™ is developed by Optimal Solutions Software LLC, based in Idaho, USA. The Optimal Solutions Management team is comprised of some of the most experienced CFD-based shape optimization personnel in the business. Since 1990, the research team has expended thousands of man-hours in designing and refining the Sculptor™ software program to its present form. Through the development of the Sculptor™ world-class, patent-pending product family, Optimal Solutions has been able to effectively address the current barriers that prevent the efficient use of digital simulation.

www.goSculptor.com

www.youtube.com/OSSculptor

Apply Sculptor to your model for free

The team at Optimal Solutions Software is happy to perform a no-cost initial design assessment on your model. Contact us today and we will obtain the deformation constraints from you and demonstrate how Sculptor can save you time and money. We have worked with all sizes of companies and have NDA's in place with most major firms and can quickly get to work on your model.

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