Reducing emissions, improving efficiency with Sculptor^TM: overview

|	
DRAG:	**-5.88%**
DESIGNS:	**100**
TIME :	**15 min**

Why a Train?

The high speed train market in recently industrialized countries is one of the most hotly contested markets in the world. Even the smallest advantage is exploited for higher sales. Fuel consumption is a significant factor now playing a role in design, sales, and maintenance of these vehicles. With that in mind a customer was looking to maximize efficiency, reduce emissions, and decrease design time.

So What?

A more efficient approach needed to be taken in order to maximize the number of designs that could be tested. Sculptor was just the tool for the job. By specifying key design parameters hundreds of designs could be generated in matter of minutes, the previous process took months.

Did They Succeed?

Sculptor^TM, coupled with modeFrontier a Multi-Objective Optimization code from ESTECO, and starCCM+ a CFD analysis tool from CD-Adapco , allowed the customer to find an aerodynamic design that decreased the drag by more than **5%**, increased aerodynamic efficiency and ultimately increased fuel efficiency. All of the design changes were completed in less than one hour, while with wind tunnels or only CFD codes it would have taken several weeks or months. Moreover, Sculptor^TM avoided time consuming operations on the Computer Aided Design (CAD) vehicle model and on the computational grid, since its morphing takes place over the CFD model directly.

OLD

NEW
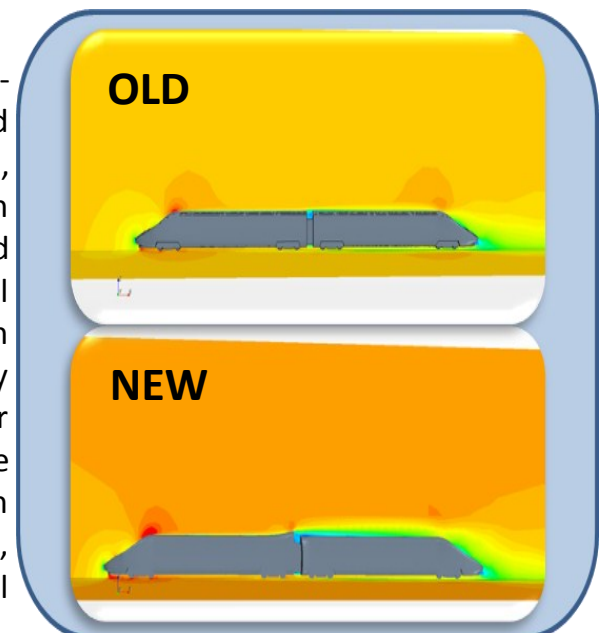
# Reducing emissions, improving efficiency with Sculptor™: details

Re-Cad	Re-Mesh	CFD Pre

| Mesh Morph | * | **85 % 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 geometry 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.

Using Arbitrary Shape Deformation (ASD) volumes, different configurations were instantly tested, without the need of re-creating the mesh. 100 different geometries were tested and one was found that reduced the drag by more than 5%.

Design envelope

The ASD volume deforms the geometry
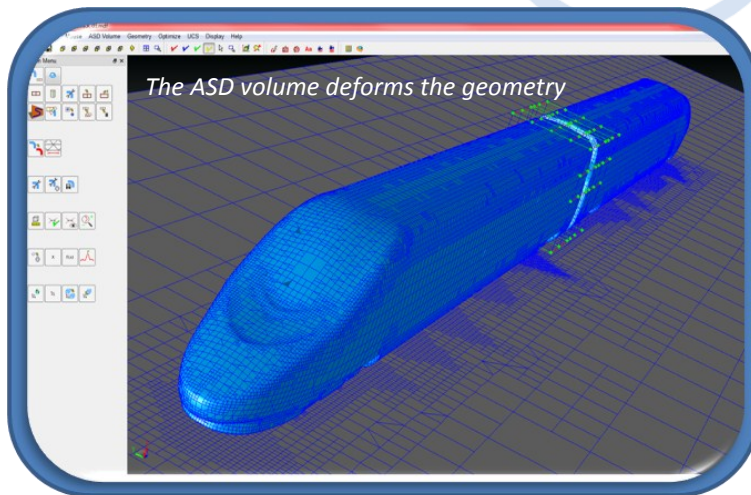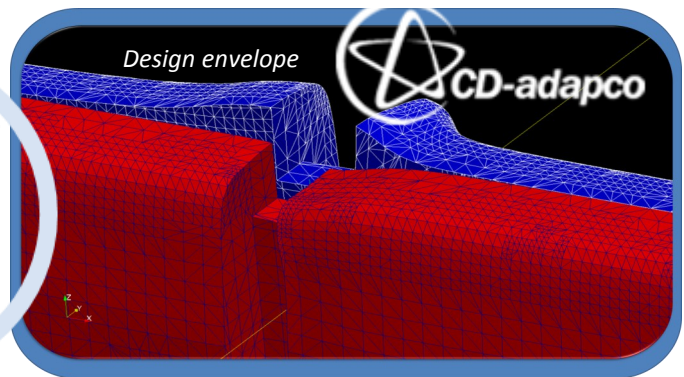
5 Control groups were defined with individual deformation vectors based on manufacturing constraints and realistic aerodynamic estimations. These groups were used as design variables in the setup of the optimization.

Sculptor™'s morphing technology combined with the 5 control groups was applied over the Computational Fluid Dynamic (CFD) model of the train. Using the optimizer to determine which configurations should be tested, Sculptor took 15 minutes to generate 36 designs. These designs were then automatically sent to the CFD code and analyzed.

modeFrontier workflow
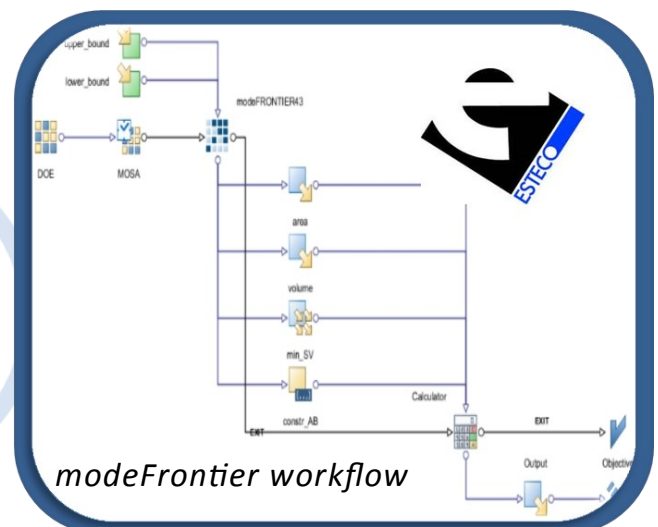
CFD and Sculptor[TM]: faster and cheaper design

Sculptor[TM], coupled with a starCCM+, allowed finding the optimal aerodynamic design in a few days, while CFD only would have taken several weeks. The total costs were 79% less with respect to the traditional design method. In the table below the breakdown of the costs is presented, based on the estimation of man-hour cost of ($90 / hour), CFD code hourly cost ($10.75 / hour) and a Sculptor[TM] hourly cost of ($10.75 / hour). 80 designs needed to be evaluated.

	Time		Cost	
	Without Sculptor	With Sculptor	Without Sculptor	With Sculptor
Time / Cost to mesh the first design	10 h	10 h	$1,008	$1,008
Time / Cost to re-CAD and re-mesh designs after initial	125 h	0 h	$12,594	$0
Time / Cost to re-set Boundary Conditions for all designs	15 h	0 h	$1,511	$0
Time / Cost to set up the case in Sculptor[TM]	0 h	2 h	$0	$201
Total Time / Cost	150 h	12 h	$15,113	$1,209

On this project, the use of Sculptor[TM] enabled the customer

to save more than $13,000 and 130 hours

About Sculptor[TM]

SculptorTM 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 SculptorTM software program to its present form. Through the development of the SculptorTM 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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