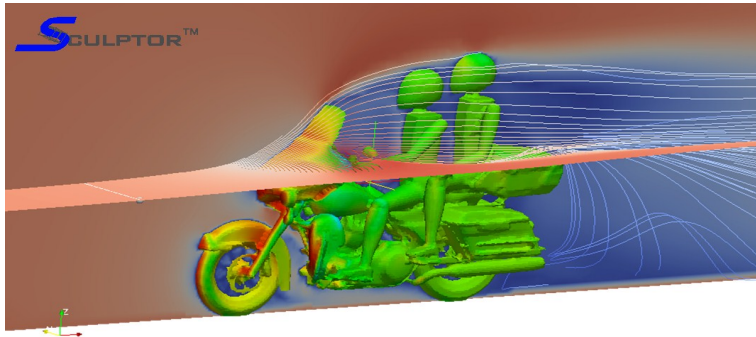




Reducing drag and enabling optimization with Sculptor™: **overview**



DRAG: - 5.13%

DESIGNS: 36

TIME: 15 min

What is Mesh Deformation?

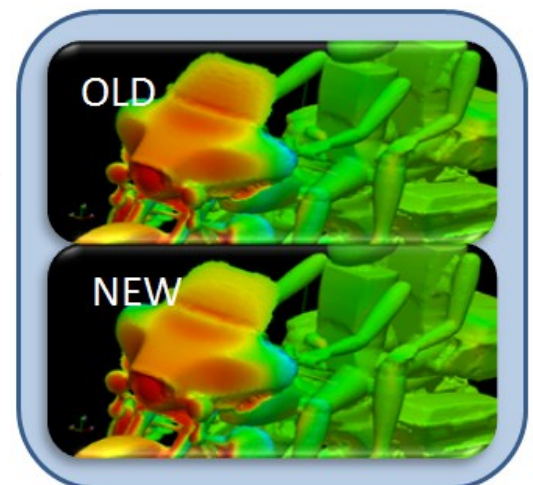
In Computer Aided Engineering a geometry has to have a mathematical definition in order for any type of physics or engineering computation to be performed. These definitions are known as meshes. The computer aided engineering term for aerodynamic calculation is computational fluid dynamics, or CFD for short. A CFD mesh is an extremely large mesh, often taking many days and weeks to create. Sculptor™ performs complex deformations to the CFD mesh in real-time, removing the need to create a new mesh every time a different geometry is tested in CFD.

What is Shape Optimization?

By parameterizing the deformations based on an arbitrary volume a computer can make thousands of new designs in the time it would take to make one new mesh. These new designs can be automatically tested and an optimal solution can be selected in a fraction of the time it would take during a traditional optimization cycle.

Sculptor™ Deformed This Geometry...

Sculptor™, enabled the deformation and optimization of this example geometry. The goal was to reduce drag by deforming the windscreen and front fairing of this 10 million cell CFD model. 36 models were analyzed, Sculptor created all of these models in 15 minutes. Without Sculptor these would have taken 40 hours to create. After the CFD analysis a geometry was found that reduced the drag by more than 5%



Reducing drag and enabling optimization with Sculptor™: details

Re-Cad

Re-Mesh

CFD
Pre

Mesh
Morph

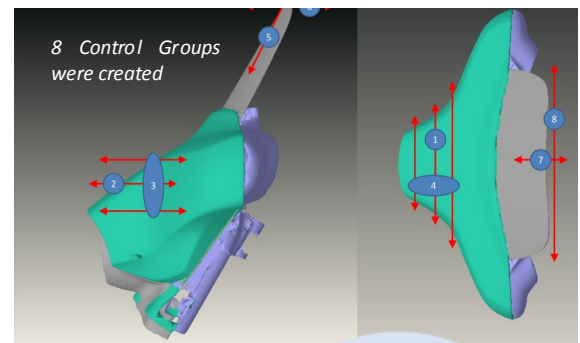
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85 % time saving with Sculptor™

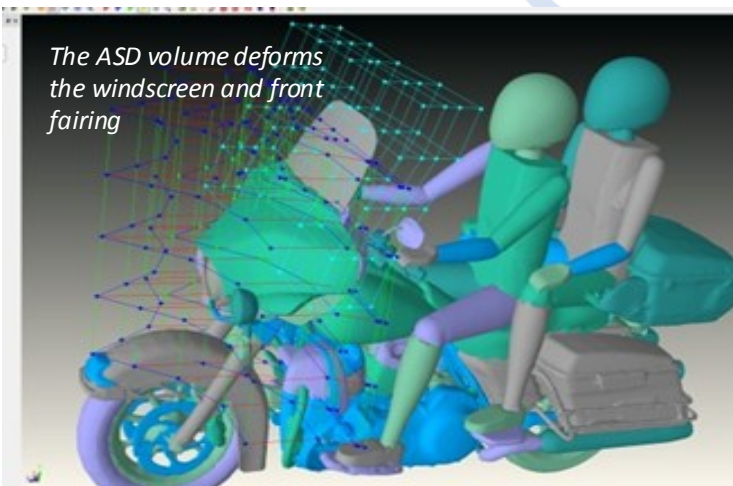
Time advantage in creating any new configuration after the initial one.
*Exports to CFD

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. 36 different geometries were tested and one was found that reduced the drag by more than 5%.



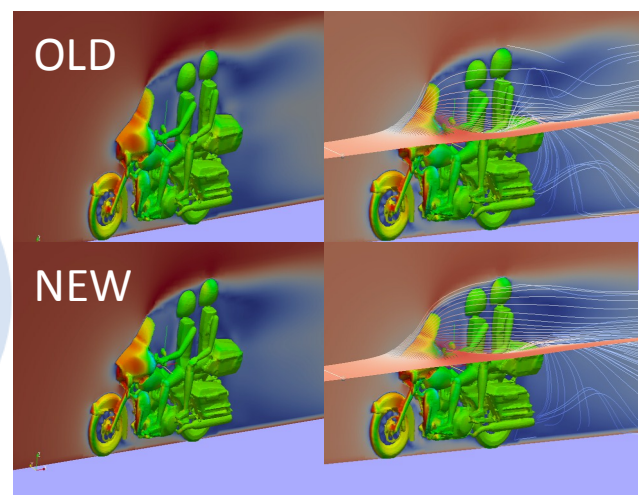
8 Control Groups were created



The ASD volume deforms the windscreen and front fairing


Sculptor™'s morphing technology combined with the 8 control groups was applied over the Computational Fluid Dynamic (CFD) model of the motorcycle. 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.

8 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.



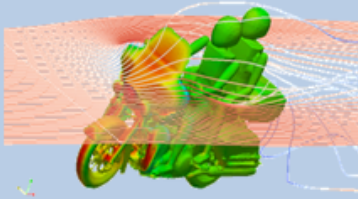
OLD

NEW



“...where complex engineering models become clay in your hands...”

CFD and Sculptor™: faster and cheaper design



79%

COST SAVINGS

Sculptor™, coupled with a CFD code, 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 manhour cost of (\$90 / hour), CFD code hourly cost (\$10.75 / hour) and a Sculptor™ 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 | 60 h | 0 h | \$6,045 | \$0 |
| Time / Cost to re-set Boundary Conditions for all designs | 10 h | 0 h | \$1,008 | \$0 |
| Time / Cost to set up the case in Sculptor™ | 0 h | 2 h | \$0 | \$605 |
| Total Time / Cost | 80 h | 12 h | \$8,061 | \$1,613 |

On this project, the use of Sculptor™ enabled the user

to save more than \$6,300 and 65 hours

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.optimalsolutions.us

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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