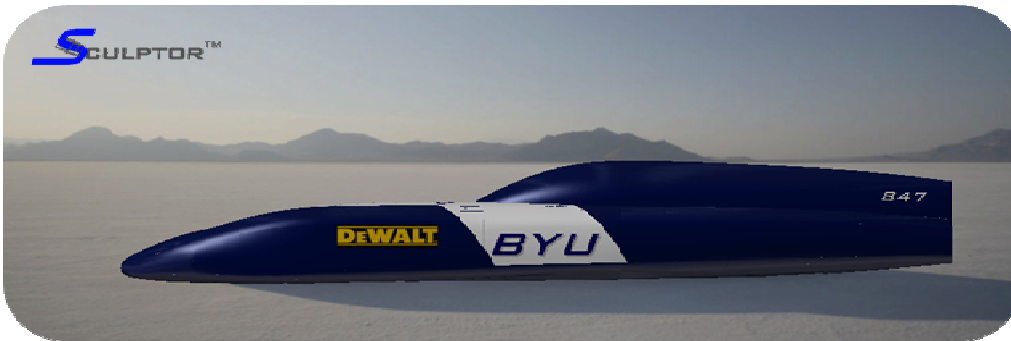




Streamliner's faster and cheaper design with Sculptor™: **overview**



DRAW: -18%

SPEED: +47%

DOWN FORCE: +400%

What is this Vehicle?

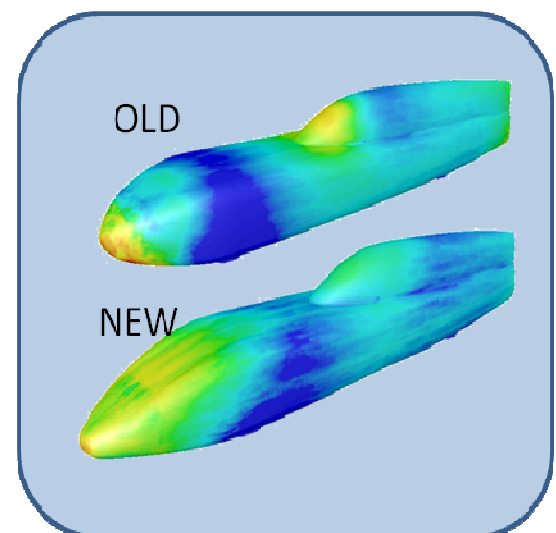
In land speed racing, a streamliner is a long, slender, high-speed vehicle with enclosed wheels. Three times a year vehicles of this kind participate in races at the Bonneville salt flats in Utah, USA. This particular Streamliner is an all electric streamliner weighing less than 500 kg that was developed by Brigham Young University in Provo, Utah, USA. The University is attempting to break a land speed record for light electric vehicles.

So What?

A new streamliner design needed to be invented, to improve the current top speed record in its category—219 km/h. A very efficient aerodynamic design was needed to reach this goal, while safety requirements had to be respected. Besides that, design cost and time had to be minimized.

Did They Succeed?

Sculptor™, coupled with a Multi-Objective Optimization code, allowed finding the optimal vehicle aerodynamic design in less than one week, while with wind tunnels or only CFD codes it would have taken several weeks or months. The shape was substantially changed, and an estimated 47% speed increase was reached. At the same time, safety was increased by 400%. This approach allowed to completely define the designs in one week, without the need of any preliminary wind tunnel tests. Moreover, Sculptor™ 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.





OPTIMAL SOLUTIONS

<http://www.optimalsolutions.us>

Streamliner's faster and cheaper design with Sculptor™: details

Re-Cad

Re-Mesh

CFD
Pre

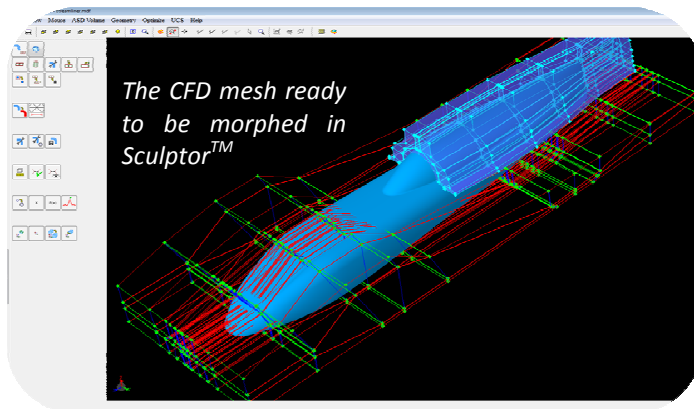
Mesh
Morph

89 % time saving with Sculptor™

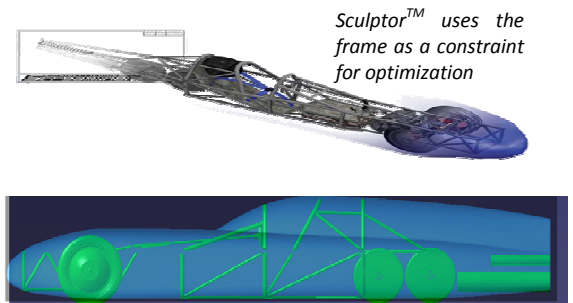
Time advantage in creating any new configuration after the initial one.
*"Exports to CFD"

Sculptor™ enables the user to easily parameterize a complex duct system, respecting the packaging constraints. It also removed the re-CAD, re-mesh and pre-process operations from each new design iteration, by modify the shape of the CFD model directly.

The surface of the streamliner needed to be shaped over a defined frame. The front end and the under-carriage had to be designed so that its aerodynamic design would generate low drag force with the needed down force. The first was beneficial in achieving the top-speed record, the second was necessary to keep the vehicle down to the ground and allow the necessary safety and traction.



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.

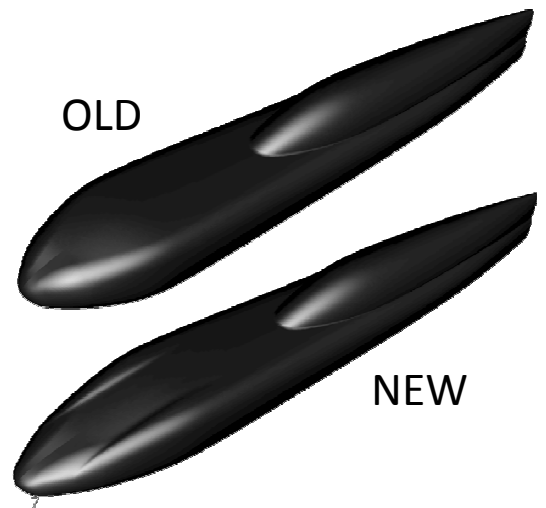


Sculptor™ uses the frame as a constraint for optimization

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.

OLD

NEW

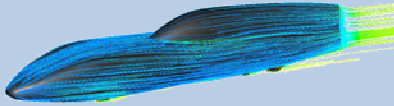




OPTIMAL SOLUTIONS

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CFD and Sculptor™: faster and cheaper design


$$+ \text{SCULPTOR}^{\text{TM}} = 81\%$$

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 81% 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™ 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	3 h	3 h	\$303	\$303
Time / Cost to re-CAD and re-mesh designs after initial	40 h	0 h	\$4,030	\$0
Time / Cost to re-set Boundary Conditions for all designs	4 h	0 h	\$403	\$0
Time / Cost to set up the case in Sculptor™	0 h	6 h	\$0	\$605
Total Time / Cost	47 h	9 h	\$4,736	\$908

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

to save more than \$3,500 and 38 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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*"...where complex engineering models
become clay in your hands..."*