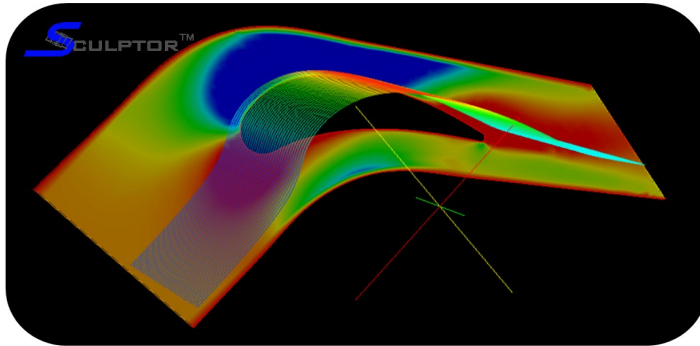


# Matching turbine blades precisely and quickly with Sculptor™: **overview**



**LARGEST NODAL DIFF:** 0.0005 in

**TIME TO MATCH:** 27 min

**TIME TO APPLY TO CFD:** 30 sec

## What is a turbine blade?

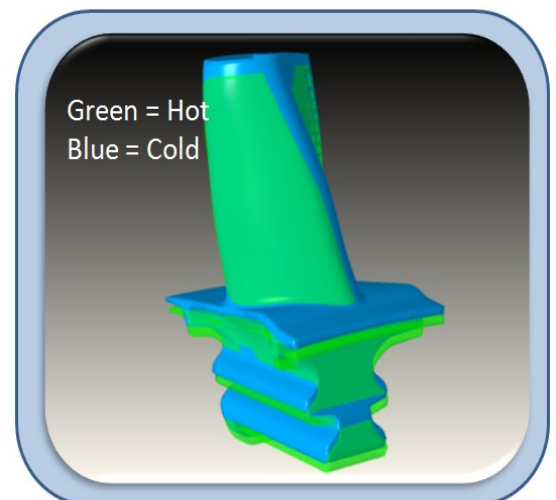
A turbine blade is a simple blade that is often combined with hundreds of other blades around a shaft or drum. Combined, these blades create a turbine which reacts in a jet engine with air thrust into the area around the blades. The air reacting with the turbine blade forces the shaft to rotate. In a jet engine this rotation assists the compressor blades that are crucial to compressing the air for the combustion of fuel.

## What needs to be matched?

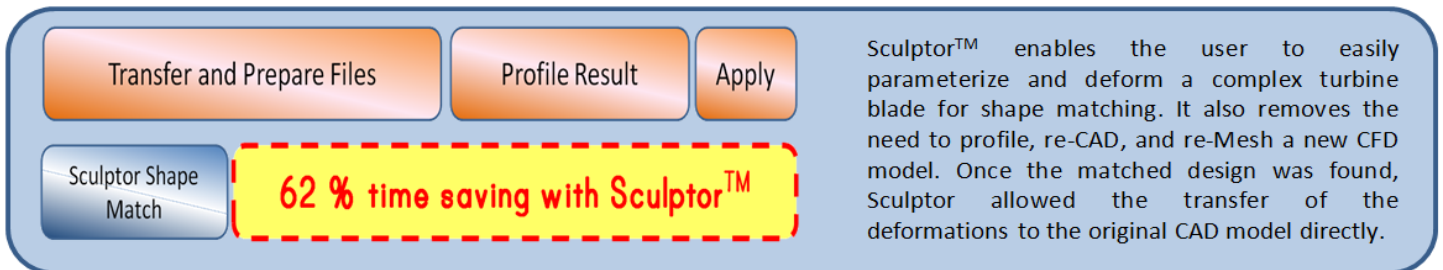
There are a number of different processes that need matching, but a basic matching need arises when the designers want to create a computational fluid dynamics (CFD) model of a non-operating blade. The blades are modeled as operating or “Hot”, using Finite Element analysis a “Cold” blade is created. The geometry of the cold blade then needs to be applied to the CFD model. There are a number of ways that this is done, but all are inefficient and costly, until now.

## Did They Succeed?

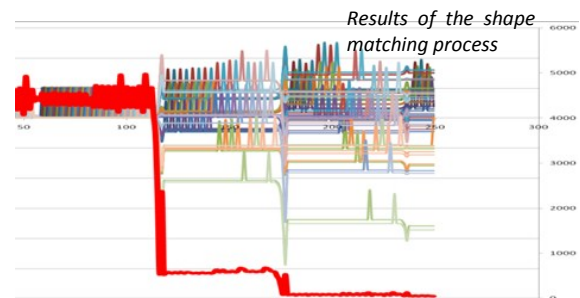
Sculptor™, enabled the customer to fit the two blades with appropriate tolerances, while minimizing the smallest difference. This was done by manipulating Sculptor’s ASD volume while minimizing the sum of the differences of each node on the Hot and Cold FEA model. After the two FEA blades were matched, the deformation was applied to the volumetric CFD mesh and in a few moments the customer had a “Cold” CFD model. The entire blade matching process took less than an hour. The deformations were applied to the CAD model using Sculptor’s Back2CAD module



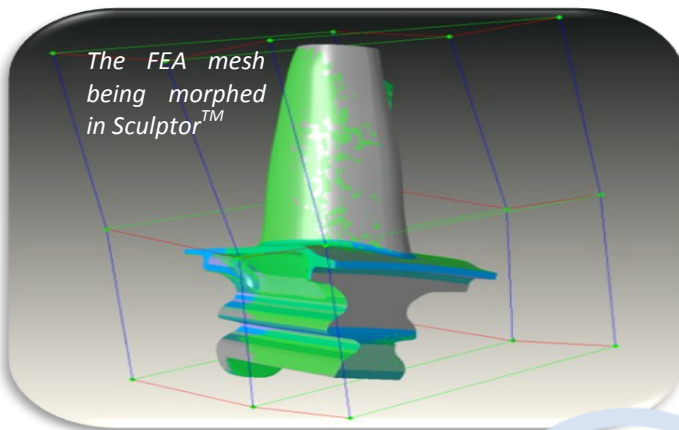
# Matching turbine blades precisely and quickly with Sculptor™: details



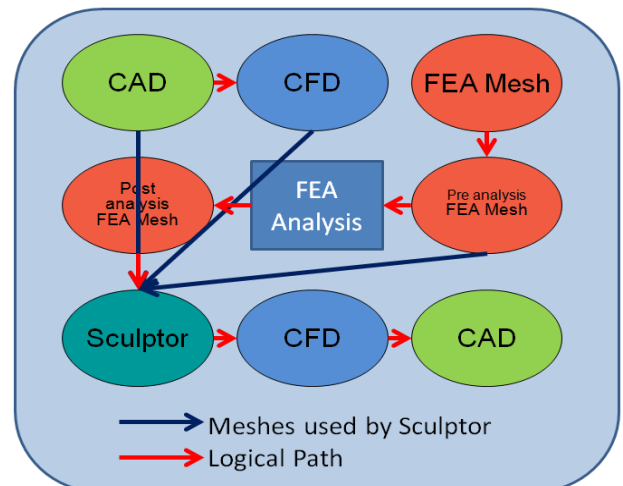
The first step was to create the appropriate meshes and geometry. First the CAD model was created, next the CFD mesh was created, and finally an FEA mesh was created and analyzed. An ASD volume was created around the undeformed FEA mesh with groups that closely mimicked the deformations that the analysis made.



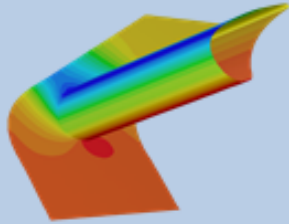
Sculptor™'s morphing technology was applied in conjunction with a script which was written to compare, node by node, the deformed and post-analysis meshes. Sculptor then made a deformation to the previously undeformed mesh and compared it to the post-analysis mesh.



After the ASD deformation that provided the closest match was determined, the volume and deformation were applied to the original CFD mesh and the original CAD. A new CFD and CAD model were then exported and ready for a new analysis



# Hot-to-Cold with Sculptor™: **fast and precise**



# 62%

**TIME SAVINGS**

Sculptor™, coupled with a custom script, allowed matching a cold FEA model to a Hot CFD model in a few hours. While the traditional process would have taken several weeks. The total costs were 62% 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/FEA 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 create Hot FEA and CFD Mesh	50 h	50 h	\$5,038	\$5,038
Time / Cost to transfer and prepare files	80 h	0 h	\$8,060	\$0
Time / Cost to slice FEA and apply deformations to CFD	14 h	0 h	\$1,411	\$0
Time / Cost to set up the case in Sculptor™	0 h	5 h	\$0	\$504
Total Time / Cost	<b>144 h</b>	<b>55 h</b>	<b>\$14,509</b>	<b>\$5,542</b>

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

**to save more than \$8,800 and 85 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.goSculptor.com](http://www.goSculptor.com)

[www.youtube.com/OSSculptor](http://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.

[info@optimalsolutions.us](mailto:info@optimalsolutions.us)

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