

RBF Morph driven by DesignXplorer

The fastest morphing add on for shape optimisation using Fluent can now be integrated in the ANSYS Workbench platform.

Product developers must quickly perform and test numerous design variations in an environment steeped in complex customer requirements and short development cycles. Faced with increasing competition, companies have to produce higher performing products and deliver in shorter time frames to remain competitive. The need to innovate has never been greater. Mesh morphing has emerged as a meaningful technology given its ability to accelerate the Simulation Driven Product Development process. RBF Morph is a unique morpher that combines a very accurate control of the geometrical parameters with an extremely fast mesh deformation, fully integrated in the CFD solving process.

The tool, initially released as RBF Morph 1.1 in July 2009, was presented at the European Automotive Simulation Conference - where it has been awarded as the "Most Advanced Approach using integrated and combined simulation methods". A further step forward has been made with the integration between RBF Morph and ANSYS Workbench. The major benefit is the coupling with any optimization tool, including the easy-to-use, workbench embedded, DesignXplorer, that makes the optimisation task effectively straightforward.

The new functionality is first described through two fundamental steps: the shape parameterisation set up within Fluent by means of the RBF Morph add on and the definition of shape parameters linked to Workbench variables. Then the shape parameters can be steered directly within Workbench and the CFD solution performed efficiently by Fluent with no I/O expenses, thanks to RBF Morph. The CFD calculation performed by Fluent becomes a solver box capable to evaluate objective functions in response to the desired input parameters, from boundary conditions to geometrical changes. As illustrated in the last part of the example, such powerful "knobs" can be used for a "what if" analysis as well as for a fully automated and efficient optimisation process, using DesignXplorer.

The proposed approach is here demonstrated with an industrial application: shape optimisation of a motorbike windshield.

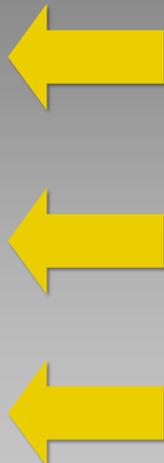


Fluent + RBF Morph = parametric CFD

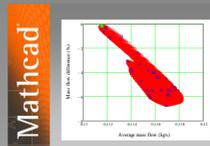
(rbf-morph "("sol-1" amp-1) ("sol-2" amp-2)...("sol-n" amp-n))



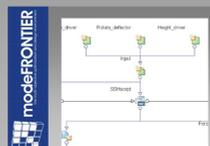
RBF Morph is an embedded tool. This means that there is no need of saving several meshes. The original Fluent case becomes a truly shape parametric CFD model. A single command line in the journal file allows to update the mesh in the new configuration combining as much shape modifications as needed. The morphing module is fully integrated in the solving stage (including parallel runs) and allows to handle very large models (hundreds millions of cells).



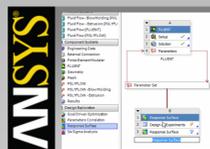
Parametric solution can be steered using the preferred optimisation tool...



Optimisation process can be automated using: internal DOE tools of RBF Morph, scripts, custom software, calculation Worksheets. MathCAD has proven to be an effective tool for post processing.



The coupling with the modeFRONTIER optimiser has been successfully tested in a complex environment, running MF on a Windows local machine and Fluent on a LINUX HPC cluster.

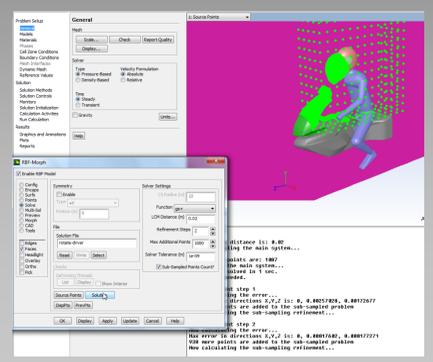


The integration with Workbench has been successfully implemented. Workbench shape parameters are defined and they can be steered using the module DesignXplorer.

RBF Morph set-up



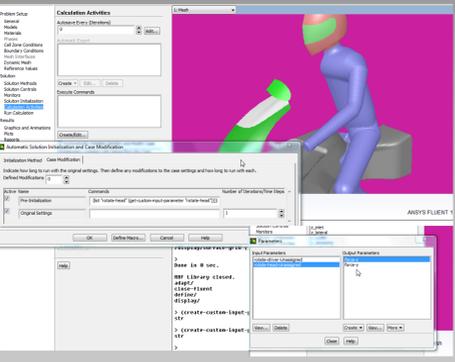
Fluent case is loaded as the baseline problem. The morphing modifiers are defined within Fluent starting from scratch or using existing RBF solutions. RBF files are saved in the working folder.



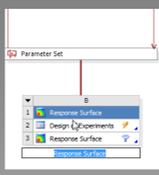
WorkBench connection



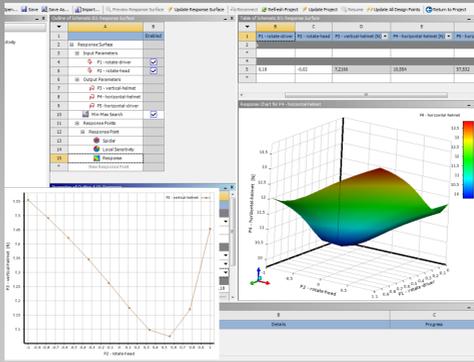
Custom parameters are defined within Fluent to control the shape. The RBF command is included in the initialization sequence. New parameters are now available in Workbench!



DesignXplorer analysis



Parametric analysis is steered using DX. DOE, automatic optimisation and post processing are easily controlled using standard DX commands.



Results

