Fraunhofer SCAI

HullCompare – A new feature in ModelCompare

HullCompare is a new add-on to ModelCompare, the SCAI plug-in for finite element (FE) pre- and post-processing tools for model comparisons. It allows users to compare the computational midsurface mesh and the so-called hull mesh. Since hull meshes are derived from CAD models, the plug-in enables them to compare an FE midsurface mesh with a CAD model.

The plug-in checks how well the midsurface mesh matches the hull surface mesh. It highlights elements in the midsurface mesh that may require correction. It also reports the error category in a particular midsurface mesh element. The plug-in provides a high-level overview of the identified problems in the midsurface mesh and an interactive, in-depth exploration of the issues.

User benefits

It is a regular task to validate that the designed midsurface mesh is a correct FE representation of a given CAD or hull surface mesh. For example, some regions might be extra or missing in the midsurface mesh, e.g., ribs/holes. Furthermore, the thickness attribute in the midsurface mesh could be inconsistent with the hull mesh. Or perhaps the shell elements are not in the exact center of the hull mesh, or they could even cut the hull surface. Many of these cases are errors for a design and simulation engineer. HullCompare identifies and reports these problems to the user, enabling users to quickly correct the affected regions in the midsurface mesh.

Our contribution

At Fraunhofer SCAI, we thrive at the crossroads of mathematics and data analysis. This enables us to provide cutting-edge tools that address the everyday needs of CAE engineers.

Before running a simulation, users often need to check if the mesh is consistent with the CAD or hull mesh design to ensure that the simulation results are as close as possible to real-world scenarios. Therefore, we have developed this tool as one step in the overall simulation data analysis workflow.

A seamless interface as a plug-in

HullCompare is available as a plug-in for GNS Animator and can also be provided as a seamless, versatile interface for the visualization tool of your choice.

Some of the problems detected by the plug-in are shown below.

Incomparable regions
Regions that are present only in one of the meshes (mid or hull mesh) can be detected. Since the corresponding region is missing in the other mesh, the results are under “Incomparable regions.” Figure 1 shows a region in the hull mesh that was not modeled in the midsurface mesh.

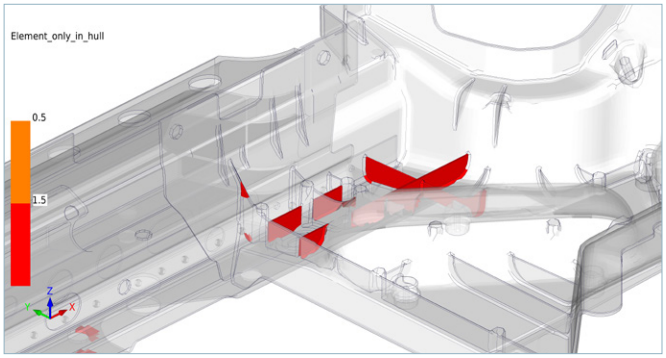

Figure 1: The regions marked in red are missing in the midsurface mesh.

Invalid thickness detection

Regions of the midsurface mesh with a thickness attribute are compared against the actual thickness of the hull mesh. The comparison methods depend on the specific region of the midsurface mesh; e.g., they differ for borders and T-joints. Figure 2 shows the detected thickness difference.

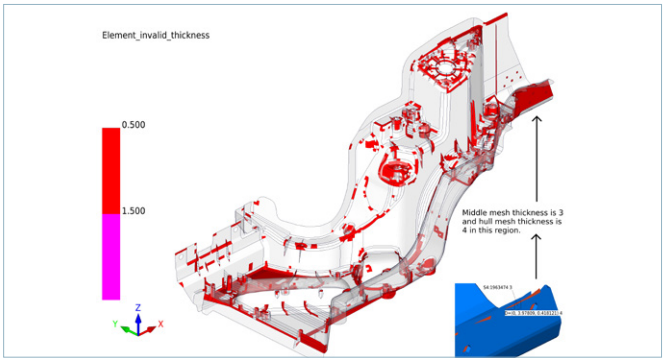

Figure 2: The regions marked in red have inconsistent thickness compared to the thickness of the hull surface.

Invalid midface detection

HullCompare detects if the midsurface mesh elements are in the center of the hull mesh, and if not, shows how far they are from the center. Here, users can select a suitable threshold to allow for minor shifts.

Midsurface edge problem detection

We can detect both the case in which the midsurface mesh edge cuts the hull mesh and the one in which the midsurface edge is far from the hull mesh edge. A threshold in the settings will determine the sensitivity. Figure 3 shows an edge in the midsurface mesh far from the hull mesh edge.

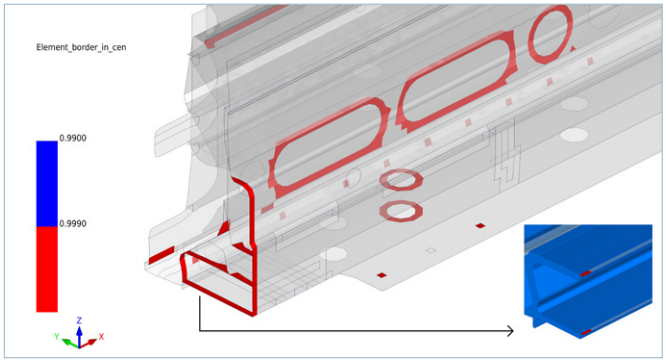

Figure 3: The midsurface mesh edge is far from the hull mesh edge (as per the threshold set by the user).

Visualizing all invalid elements at once

It is also possible to display all invalid midsurface mesh elements at once. As a result, the user gets an overview of the various errors in the midsurface mesh. Figure 4 shows all the detected elements, including one of the problems outlined so far.

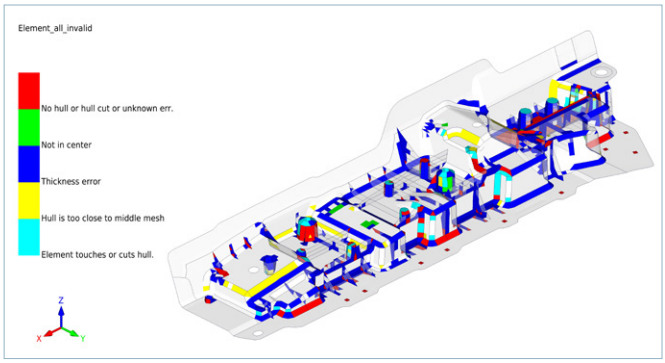

Figure 4: Viewing all the midsurface mesh elements with some issues.

Other useful features

The plug-in allows users to analyze hull meshes from multiple files loaded into multiple slots. The midsurface mesh can also have solid elements. Figure 5 shows the results in such a case; here, only one test is performed to assess how closely it matches the hull mesh.

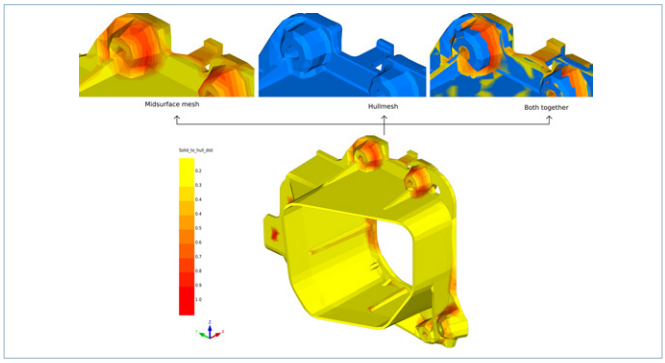

Figure 5: Detection of some issues in the midsurface mesh that is made up of solid elements. The hull mesh is shown in blue color.

Contact

Fraunhofer Institute for Algorithms and Scientific Computing SCAI
Schloss Birlinghoven 1
53757 Sankt Augustin
Germany

Mandar Satyanath Pathare
Phone +49 2241 14-4007
mandar.satyanath.pathare@scai.fraunhofer.de
www.scai.fraunhofer.de/ndv

Distributed by

scapos AG
Schloss Birlinghoven 1
53757 Sankt Augustin
Germany

info@scapos.com
www.scapos.com

Model Compare