Altair® AcuSolve® 2025

Altair AcuSolve Surface Processing

Updated: 11/13/2024

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AcuSolve Surface Processing

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Auto_Wall

AcuSolve introduces a new feature that greatly simplifies your interaction with the set-up of CFD models that often contain many complex internal and external surfaces. In the classical approach conditions on each surface in the model, or groups of surfaces, must specifically be defined and applied, including standard wall conditions. With the new approach, all surfaces except for inflow, outflow, symmetry, slip and far-field are processed automatically by AcuPrep when *type* = auto_wall is specified on model surfaces. AcuPrep processes the AUTO_WALL command by first identifying whether a surface is internal or external and then interrogating the model for parent volumes and attributes. Once this information is obtained, the surface sets are sorted and prepared for the supported scenarios. Boundary conditions are applied appropriately when necessary and are not applied when not needed. Output sets for post-processing are created in all cases. When auto_wall is used, reference frame settings applied on volumes will be inherited by the appropriate surfaces. When interfaces are located within the CFD domain for mesh motion applications, auto_wall will automatically split interface surfaces, create the interface surface mechanism with gap or gap factor, and appropriately assign boundary conditions.

Surface groups that are processed by the auto_wall functionality are potentially reorganized and therefore a new naming convention is introduced. These newly created groups will begin with AUTO followed by the parent volume set name and ending with the type of condition applied. As an example, a wall condition applied on the boundary of the UpstreamFluid volume set would result in a group named AUTO UpstreamFluid wall. More examples are shown below.

> **Note:** Baffle creation is not supported via the auto_wall mechanism.

Auto_Wall Use Cases

Below are example use cases highlighting the behavior of auto_wall in various scenarios. In each example the surfaces in blue are affected by the usage of auto_wall.

> **Note:** The blue surfaces shown are not necessarily the only surfaces affected.

Solid-Solid, Same Motion

When two solids of different material are in contact with each other the interfacing surfaces will be written to a separate output set. No boundary condition is written in this case, but the surface group is written for post-processing. In the image below the interface surfaces between a CPU chip and the PCB are written to two separate output sets. Sample naming for the pair of output sets is shown below.

AUTO CPU wall

AUTO PCB wall

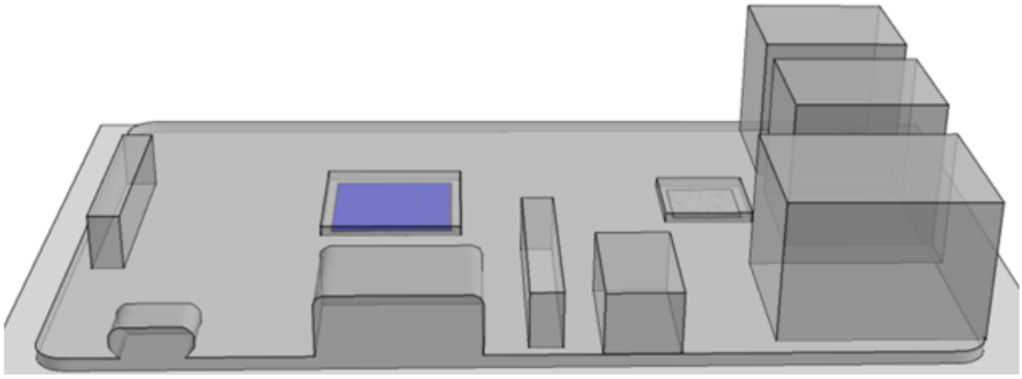

Figure 1: CPU/PCB Interfaces Shown in Blue

Solid-Solid, Different Motion

When two solids are in contact with each other and different motion conditions are applied to each volume the interfacing surfaces will be written out to separate output sets. No boundary condition is written in this case, but the surface group is written for post-processing. In situations where mesh motion is specified internal surfaces will be split whereas when a reference frame is used no splitting will take place. In the image below the interface surfaces between a wheel rim and tire are written to separate output sets. Sample naming for the pair of output sets is shown below.

AUTO Rim wall

AUTO Tire wall

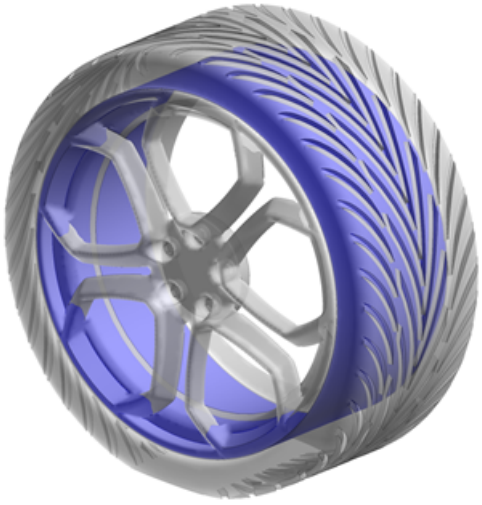

Figure 2: Rim/Tire Interface Shown in Blue

Fluid-Solid, Same Motion

When fluid and solid media are in contact with each other and the same motion (or no motion) conditions are applied to each volume the interfacing surfaces will be written out to separate output sets. In the image below the interface surfaces between the cabin air and the seats are written to separate output sets. Sample naming for the pair of output sets is shown below.

AUTO Air wall

AUTO Seats wall

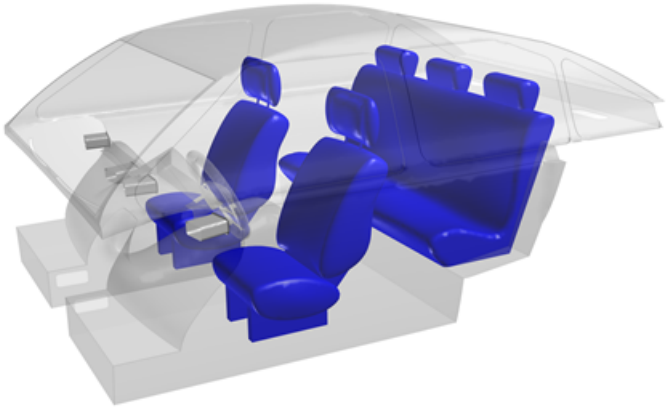

Figure 3: Car Cabin Seats/Air Interface Shown in Blue

Fluid-Solid, Different Motion

When fluid and solid media are in contact with each other and different motion conditions are applied to each volume, the interfacing surfaces will be written out to separate output sets and the motion applied to the volumes will be inherited by the appropriate surfaces. In cases where mesh motion is specified internal surfaces will be split whereas in cases where a reference frame is used no splitting will take place. In the image below the interface surfaces of the fan are written to separate output sets. Sample naming for the pair of output sets is shown below.

With mesh motion	**AUTO Fan interface**	**AUTO air interface**
With reference frame	AUTO Fan internal	AUTO air internal

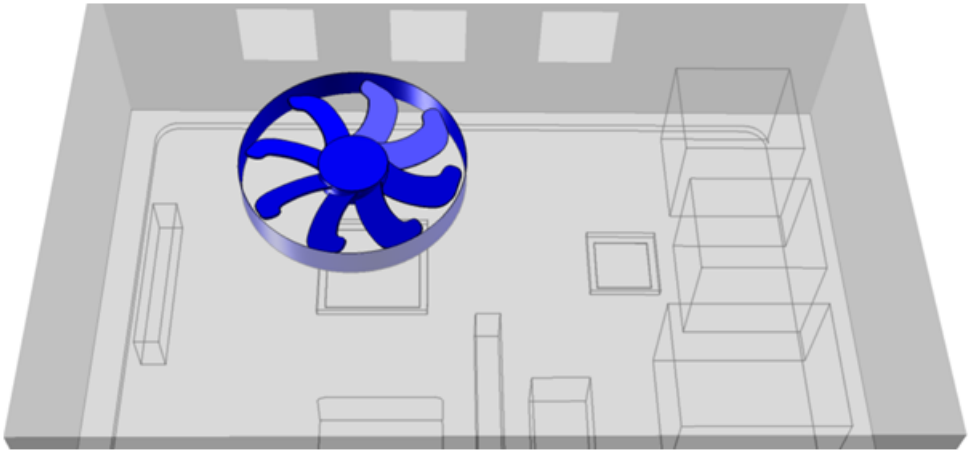

Figure 4: Fan/Air Interface Shown in Blue

Fluid-Fluid, Same Motion

When two fluid media are in contact with each other and the same motion conditions are applied to each volume the interfacing surfaces will be written out to separate output sets and the motion applied to the volumes will be inherited by the appropriate surfaces. In the image below the interface surfaces between the upstream and downstream volumes of a pipe flow simulation are written to separate output sets. Sample naming for the pair of output sets is shown below.

AUTO UpstreamVolume internal

AUTO DownstreamVolume internal

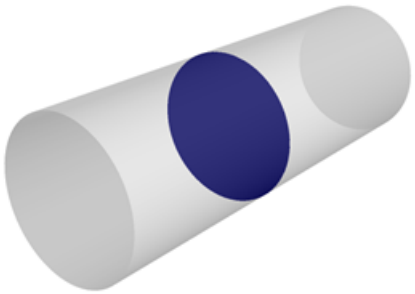

Figure 5: Fluid/Fluid Interface Shown in Blue

Fluid-Fluid, Different Motion

When two fluid media are in contact with each other and different motion conditions are applied to each volume the interfacing surfaces will be written out to separate output sets and the motion applied to the volumes will be inherited by the appropriate surfaces. In cases where mesh motion is specified internal surfaces will be split whereas in cases where a reference frame is used no splitting will take place. In the image below the interface surfaces between the rigid body motion zone of the ship hull and the interpolated mesh motion zone are written to separate output sets. Sample naming for the pair of output sets is shown below.

AUTO HullVolume internal

AUTO WaterVolume internal

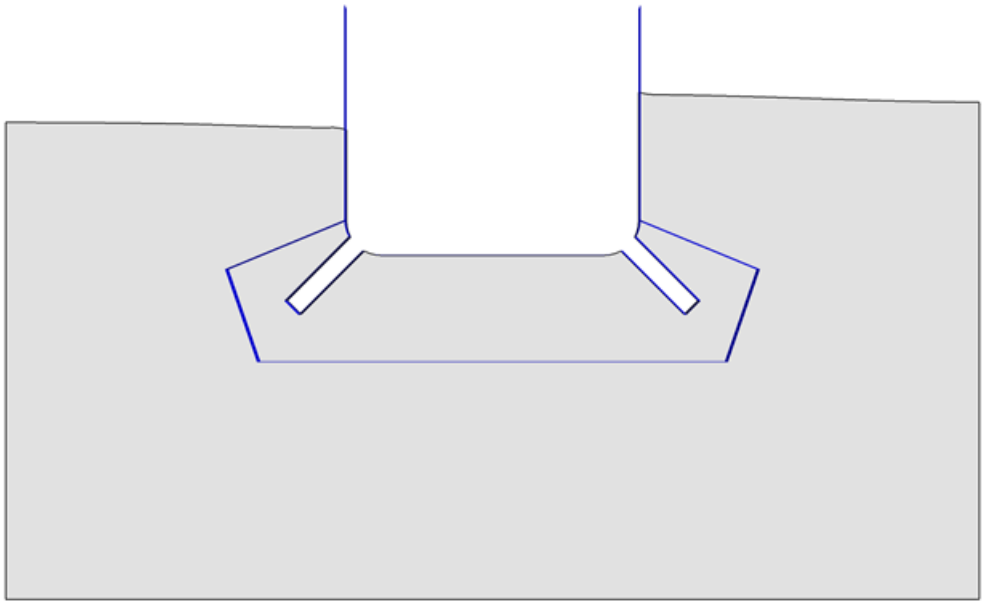

Figure 6: Fluid/Fluid Interface Shown in Blue

Composite Use of Auto Wall

All surfaces specified with *type* = auto_wall will be processed at the same time. An example of how a larger collection of surfaces is handled is given below. In this scenario a pipe geometry, consisting of two cylindrical volumes, has been imported. The volumes are UpstreamFluid and DownstreamFluid. You would like to run a simple pipe flow analysis and specify the same fluid material model on both volumes. You will select one exterior circular surface to specify as an INLET and the opposite exterior circular surface as an OUTLET. The remaining surfaces are set to WALL with *type* = auto_wall.

The set of auto_wall surfaces are first examined to determine if they are internal or external and then interrogated for parent volumes and attributes. After processing, surface groups are created with the following naming convention: AUTO <parent_volume_name> <surface_type.

In this example, each of the fluid domain volumes has one external and one internal auto_wall surface. The external surfaces are processed and the result is in one set for each volume. The surface groups are named AUTO UpstreamFluid wall and AUTO DownstreamFluid wall, respectively. Finally, the interfacing surfaces are processed and result in the AUTO UpstreamFluid internal surface group, and a corresponding AUTO DownstreamFluid internal, not shown. No boundary condition is applied to the internal surfaces.

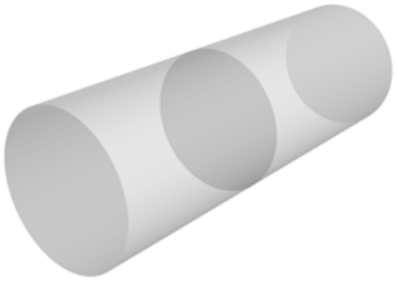

Figure 7: Initial Geometry

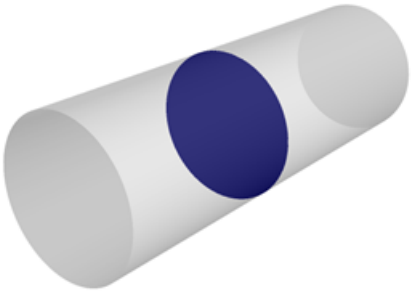

Figure 8: AUTO UpstreamFluid Internal

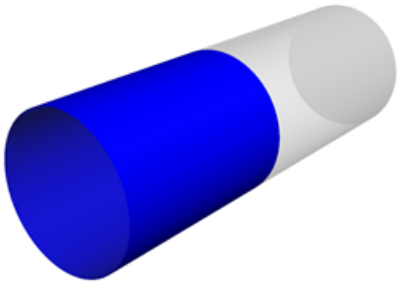

Figure 9: AUTO UpstreamFluid Wall

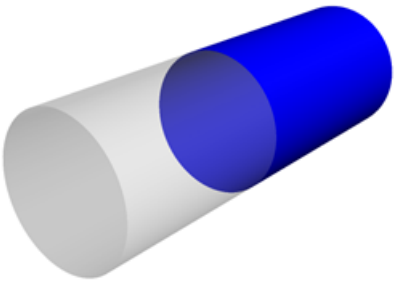

Figure 10: AUTO DownstreamFluid Wall

THERMAL_SHELL

AcuSolve introduces a new feature that creates zero physical thickness volumetric shell elements from surface elements. These elements are used for heat conduction analysis as solid media only. Shell

elements can have multiple layers, each with different thicknesses and material models. This command can also be provided together with two dynamic *surface_sets* which can be used to set thermal boundary conditions on the two sides of the shells. The *surface_set* paired with what is given in the THERMAL_SHELL command is referred to as *shell_inner* while the *surface_set* on the opposite side of the shell element is referred to as *shell_outer*. A schematic of the shell construction is shown below.

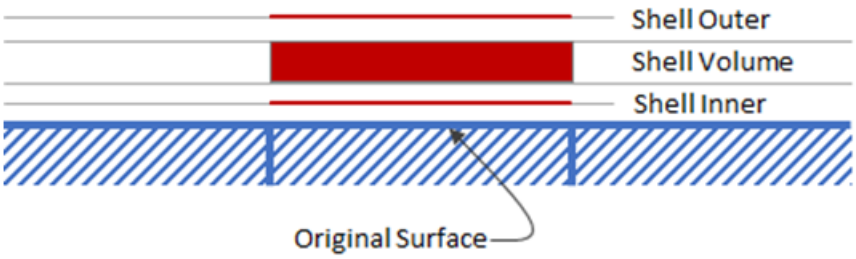

Figure 11:

In the image below the exterior surfaces of a car cabin are created using the THERMAL_SHELL command.

Note: Different THERMAL_SHELL commands would likely be used to define the glass, roof, doors, floor and console construction separately.

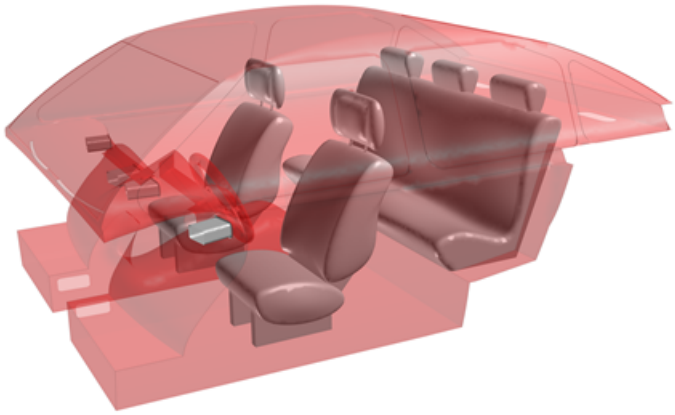

Figure 12: Thermal Shells Created on Car Cabin Surfaces

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