Set Symmetry

Introduction

In many instances, a modeler can take advantage of symmetry present in a problem to reduce the computational complexity of a subsequent analysis. EnSight can impart visual realism to such models by mirroring parts around any or all axes of the part's reference frame. Although the mirrored portions appear identical to the source part (except for the reflection), they are only client-based and cannot be used for calculation. For example, you cannot start a particle trace in one half and expect the trace to cross the plane of symmetry into the other half (although you can make the particle trace part symmetric as well).

EnSight also provides "true" or "computational" symmetry operations (mirror, rotational, translational) as an attribute of the part's reference frame. With computational symmetry, you can trace particles across a periodic boundary.

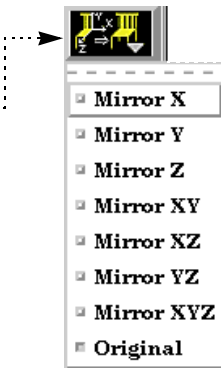
Both types of symmetry are based on the part's reference frame. Although you can use simple symmetry without having to manipulate the frame, more advanced usage of symmetry requires a working knowledge of frames. See **How To Create and Manipulate Frames** for more information.

Basic Operation

Graphical Symmetry

Graphical symmetry is an attribute of parts. You can enable display of a mirrored copy of a part into one or more of the seven octants (opposite of +,+,+) of the part's reference frame. To display graphical symmetry:

1. **Select the desired part(s) in the Main Parts list.**
2. **Click Part in the Mode Selection area to enter Part mode.**
3. **Click the Symmetry pulldown and select the desired octant(s) from the menu.**



Recall that symmetry is performed with respect to the reference frame of the part. The frame's axes define the partitioning of space into the octants that attached parts are mirrored into. If the symmetry operation did not produce the desired effect, it is probably due to the fact that the part's frame is not aligned with the plane of symmetry as designed for the model. The solution is to create a new frame, assign the part(s) to the new frame, and position the frame such that two of its axes lie in the plane of symmetry. There operations are discussed in **How To Create and Manipulate Frames**.

Computational Symmetry

Computational symmetry lets EnSight properly handle unstructured and structured models with periodic boundary conditions. Unlike graphical symmetry, computational symmetry can handle rotational and translational symmetry, in addition to mirror.

You enable computational symmetry by selecting the frame, specifying the type (Mirror, Translational, Rotational), and setting type specific attributions (such as the rotation angle and the number of instances to create). Each part assigned to the frame will be updated on the server to reflect the specified symmetry.

Note that each new instance of a part created through computational symmetry creates a new part on the server.

To use computational symmetry, you will need to enable Frame Mode if it isn't already enabled. (Edit > Preferences... General User Interface - Frame Mode Allowed). Then:

1. **Click Frame in the Mode Selection area to enter Frame mode.**

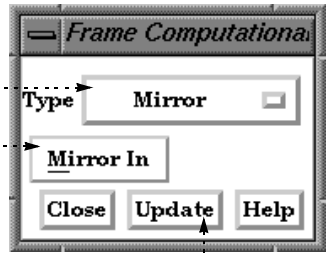
2. **If the default frame (frame 0) is not correctly positioned for the desired symmetry operation, create a new frame, position the frame in the proper location and orientation, and assign the part(s) to the new frame. (See How To Create and Manipulate Frames for details.)**

3. **Select the desired frame.**

4. **Click the Computational Symmetry Attributes Icon.**

The remaining steps depend on the type of symmetry desired.

Mirror Symmetry is similar to graphical symmetry as described above.

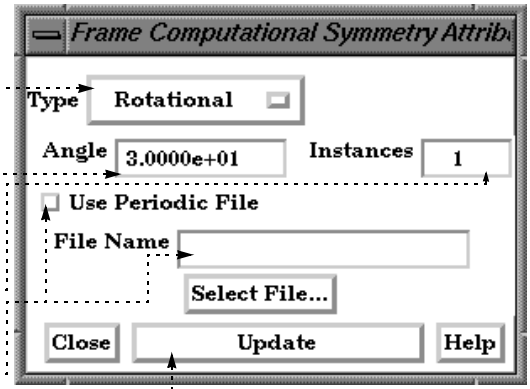


5. **Select Mirror from the Type pulldown.**

6. **Select the desired octant(s) from the Mirror In pulldown.**

7. **Click Update.**

Rotational Symmetry creates instances by rotating around the Z axis of the frame the specified number of degrees. The selected frame's Z axis must be aligned with the desired symmetry axis.



5. **Select Rotational from the Type pulldown.**

6. **Set the desired rotation angle (in degrees) in the Angle field.**

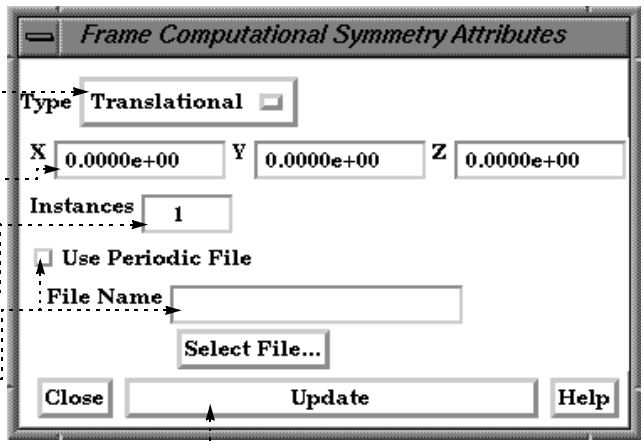
7. **Set the desired number of instances in the Instances field (number 1 is the original, set Instances to 2 to yield one copy).**

8. **If a periodic match file is available, toggle Use Periodic File and enter the file name.**

Periodic match files are discussed below.

9. **Click Update.**

Translational Symmetry creates instances in the direction of the specified translation vector. The translation vector is first rotated by the frame's rotation, but is independent of the frame's origin location.



5. Select Translational from the Type pulldown.

6. Enter the desired translation vector in the XYZ fields and press return.

7. Set the desired number of instances in the Instances field (number 1 is the original, set Instances to 2 to yield one copy).

8. If a periodic match file is available, toggle Use Periodic File and enter the file name.

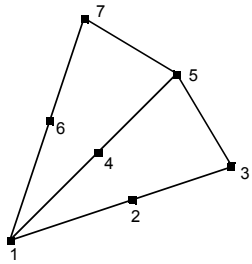
Periodic match files are discussed below.

9. Click Update.

Periodic Matching for Computational Symmetry

When a model is created with periodic boundary conditions, there is typically a built-in correspondence or "match" between certain nodes and elements. For example:

The elements defined by nodes 1,2,3 and nodes 1,6,7 should match when rotated about an axis passing through node 1 (perpendicular to the screen). When another instance is created, node 2 matches with 6 and node 3 matches with 7.



When instances are added to a part, it is desirable to eliminate these duplicate nodes. Without a match file, EnSight will attempt to find and remove them using a hashing scheme. This method works quite well, but may not find all duplicates. (Remaining duplicates are usually noticed when the part is in feature angle representation since EnSight treats elements with duplicate nodes as separate – even if they are coincident.)

Note that if you have a periodic match file you do not need to specify the rotation angle in the Frame Computational Symmetry Attributes dialog – the value is provided in the file.

A user-supplied matching file can be used to quickly find and remove all duplicates. The match file is a simple ASCII text file. The file for the example above would be (the text in italics is not part of the file):

rotate	*specifies rotational symmetry*
52.34	*the angle of rotation (in degrees)*
3	*the number of node pairs to follow*
1 1	*first node pair*
2 6	*second node pair ...*
3 7	

See **Symmetry** for more information on periodic match files.

See Also

How To Create and Manipulate Frames