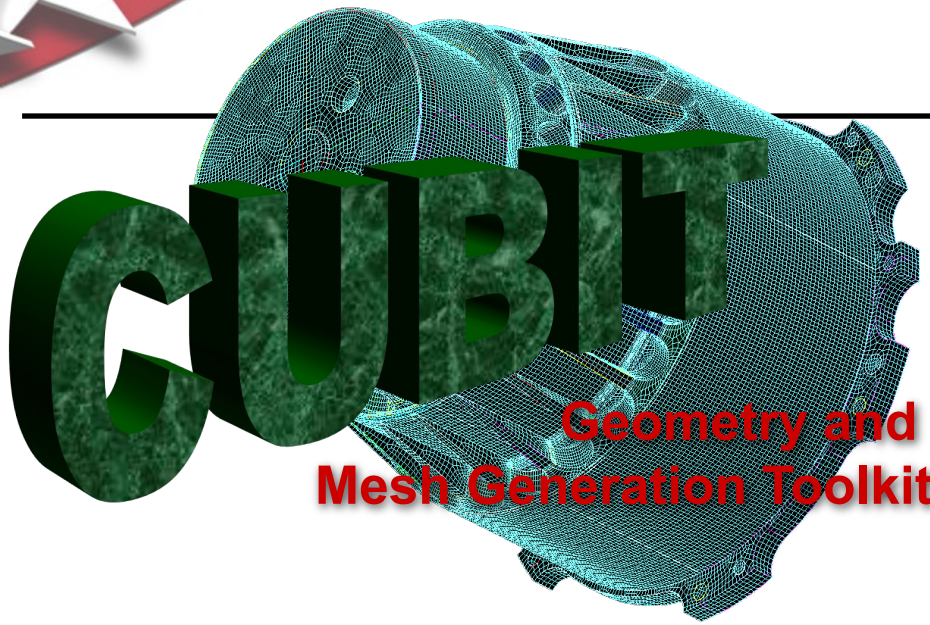


Simulation Modeling Sciences

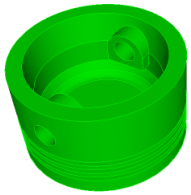
CUBIT Fast-Start Tutorial

12. Geometry for Sweeping II

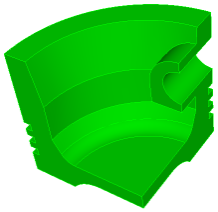
Sandia National Laboratories

The Basic CUBIT Process

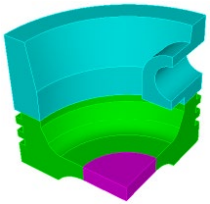
Simulation Modeling Sciences



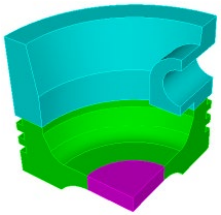
1 Import Solid Model



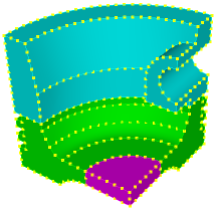
2 Simplify Geometry



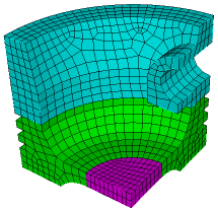
3 Decompose Geometry



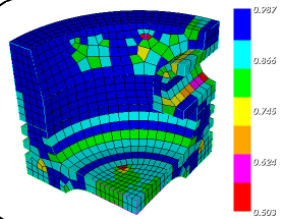
4 Imprint & Merge



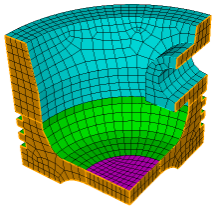
5 Set Schemes & Intervals



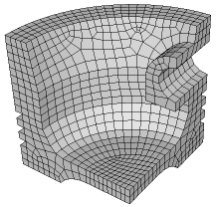
6 Mesh



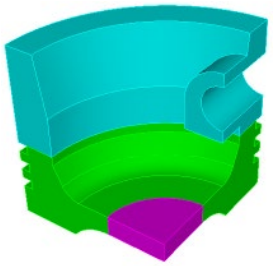
7 Check Quality



8 Apply B.C.s



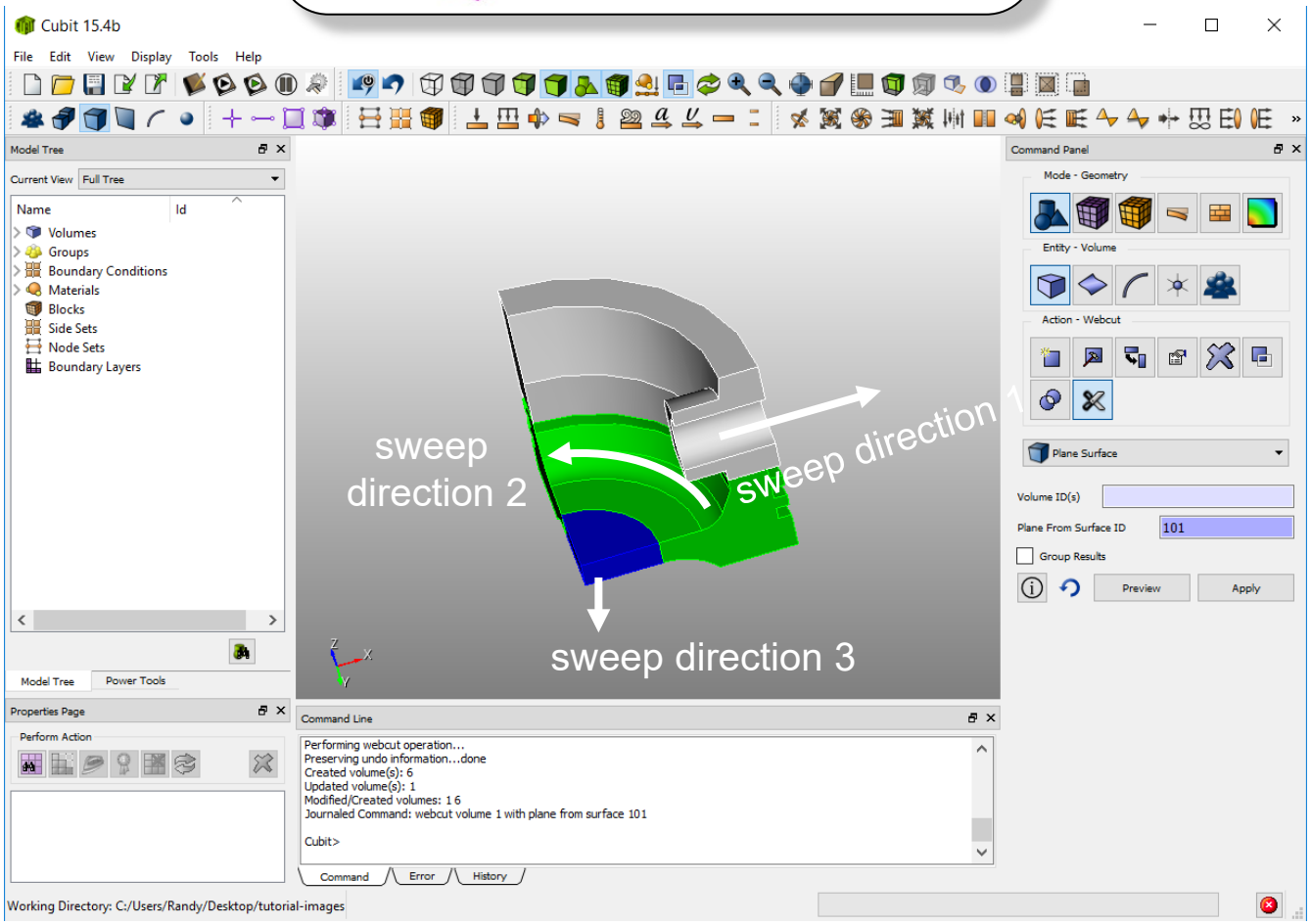
9 Export Mesh



3

Decompose Geometry

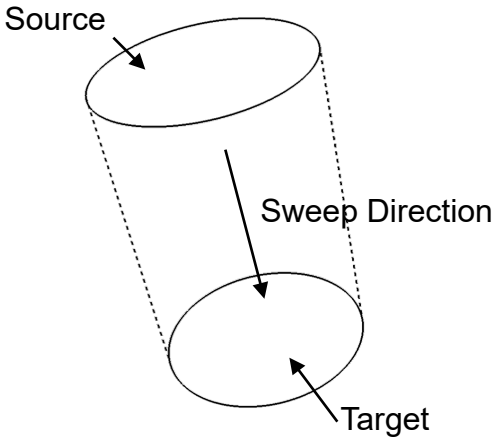
Cut the model into sweepable volumes

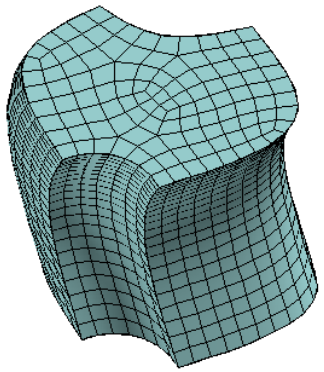


Volumes are now individually sweepable

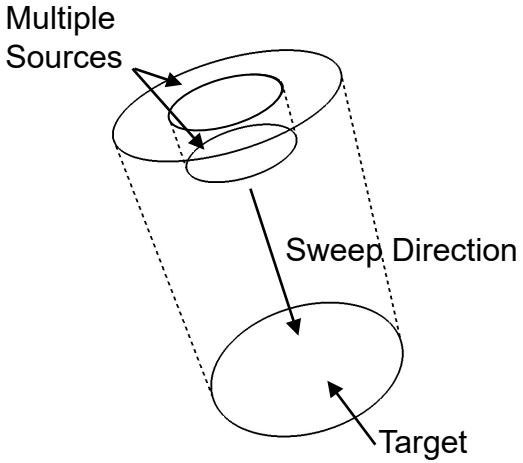
Sweep Scheme (Review)

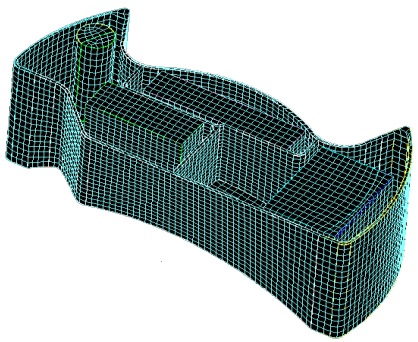
One-to-one



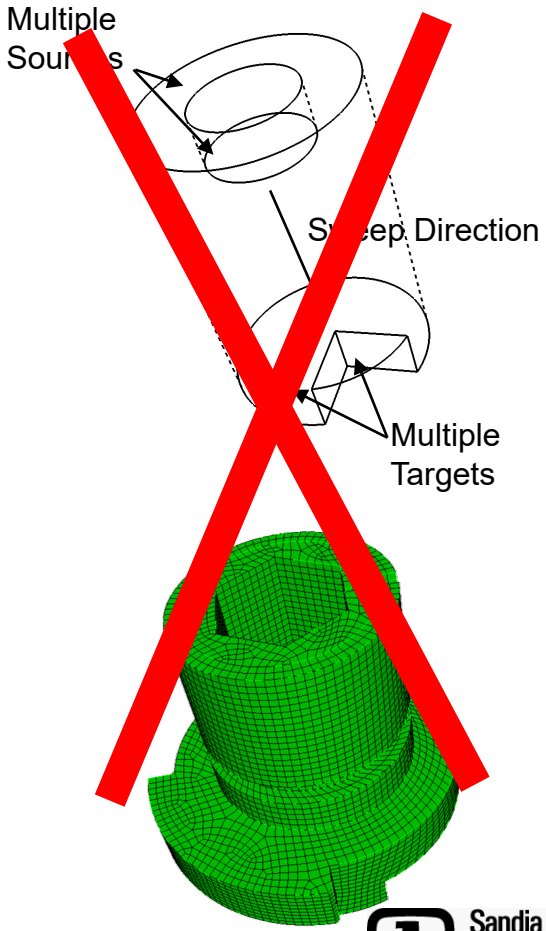


Many-to-one

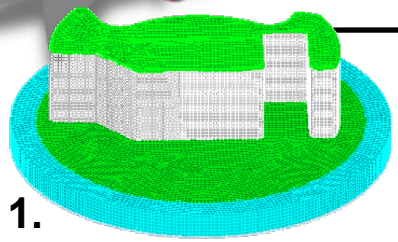




Many-to-many

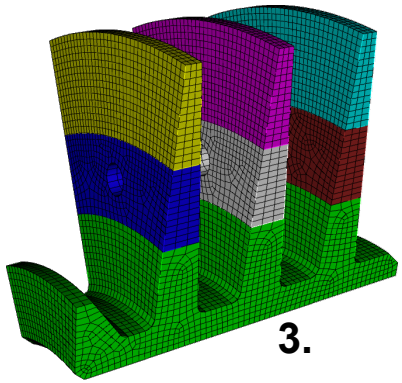


Common Techniques for Sweep Decomposition



1.

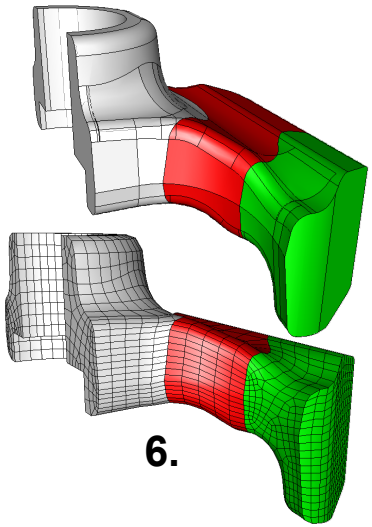
1. Find One-to-one: Locate the logical one-to-one and many-to-one sweep paths and webcut to isolate (see exercise 1 from fast-start 10)



3.

2. Coring: Core out the center of a cylindrical type object. Use a radial sweep and a top-to-bottom sweep (see exercise 2 from fast-start 10)

3. Multiple sweep directions: Cut to avoid features not in the sweep direction

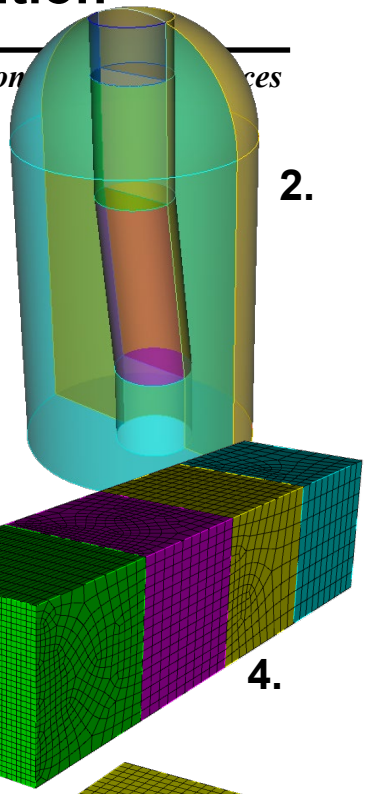


6.

4. Graded Meshes with pave-sweep: Cut multiple times in direction of grade. Alternate pave-sweep directions

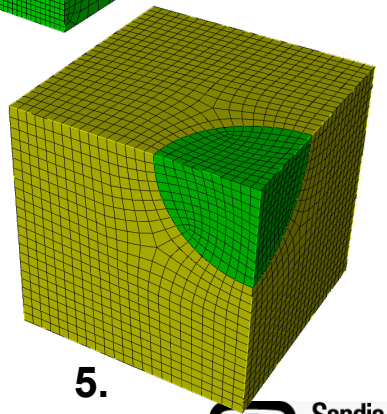
5. Midpoint Subdivision: Cut volumes so the polyhedron scheme can be used

6. Modify surfaces with tweak and composite tools to make volumes sweepable



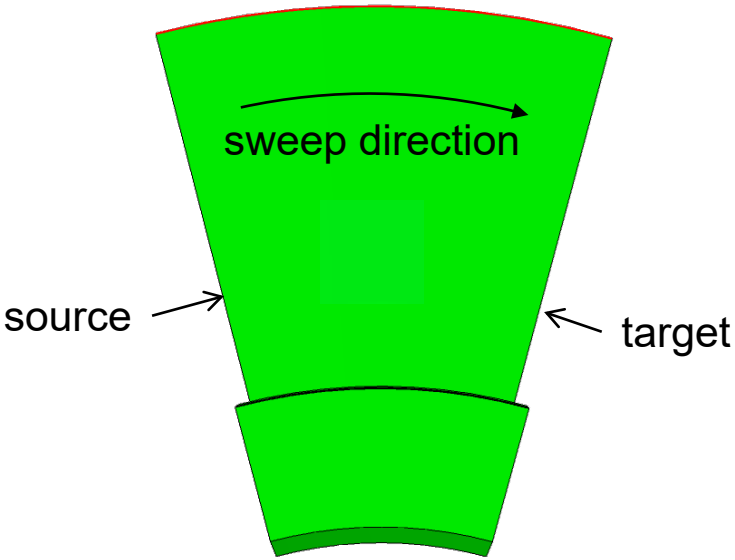
2.

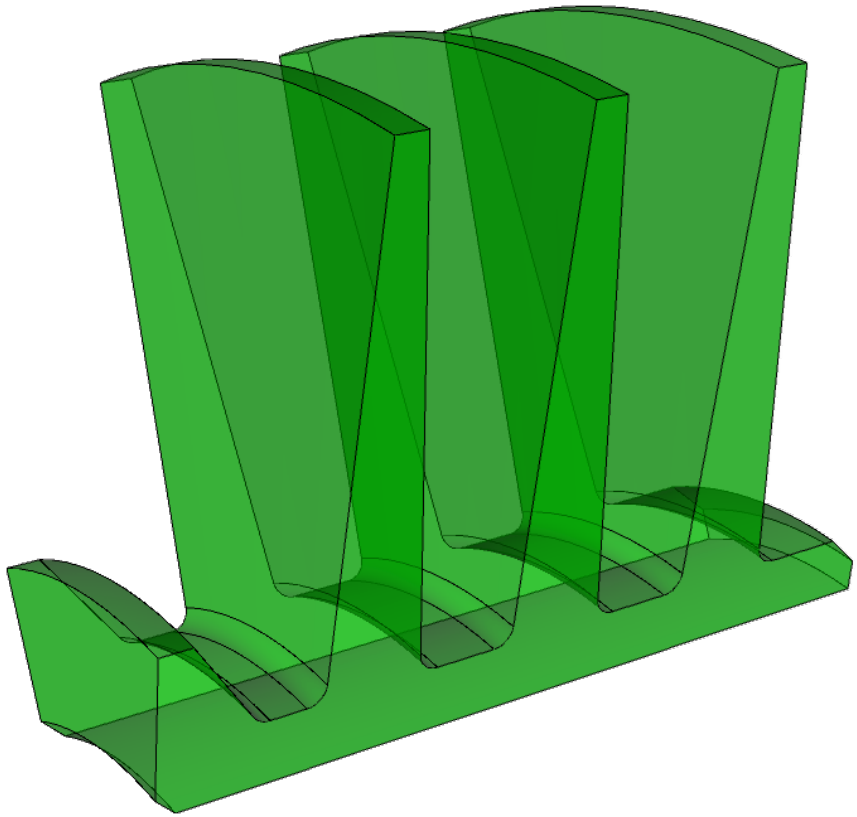
4.



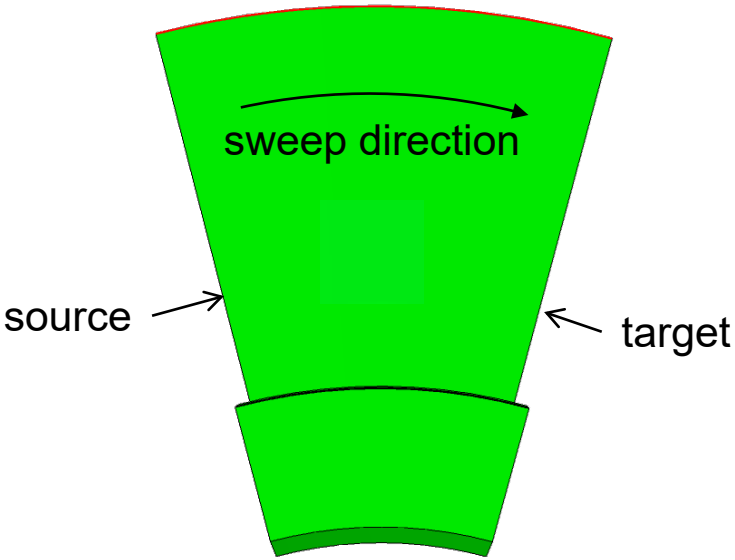
5.

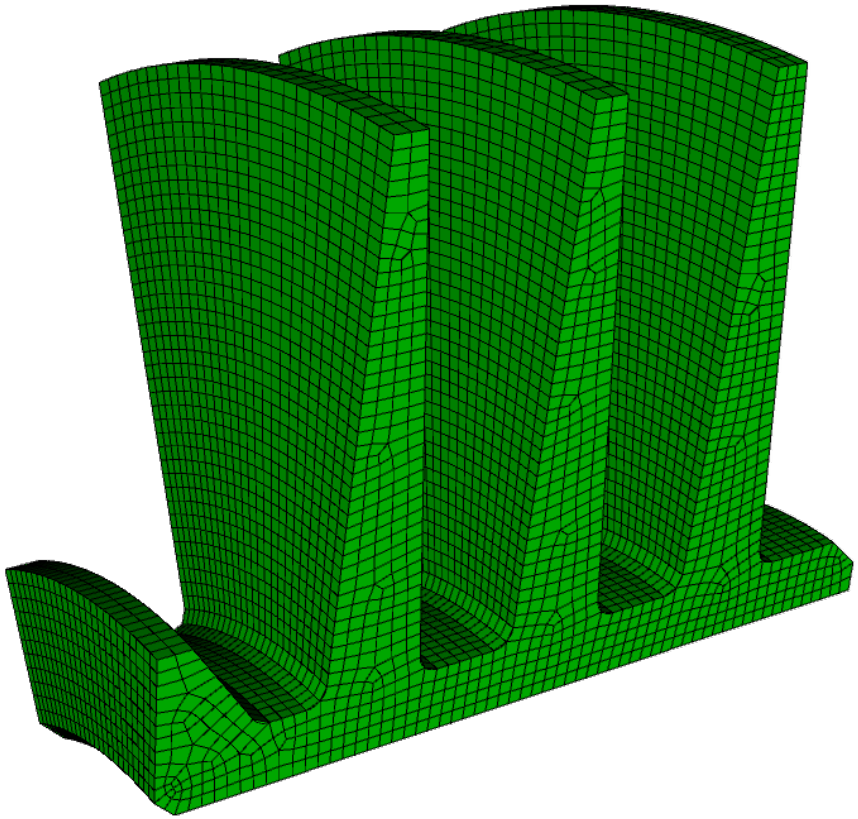
Multiple Sweep Directions





Multiple Sweep Directions

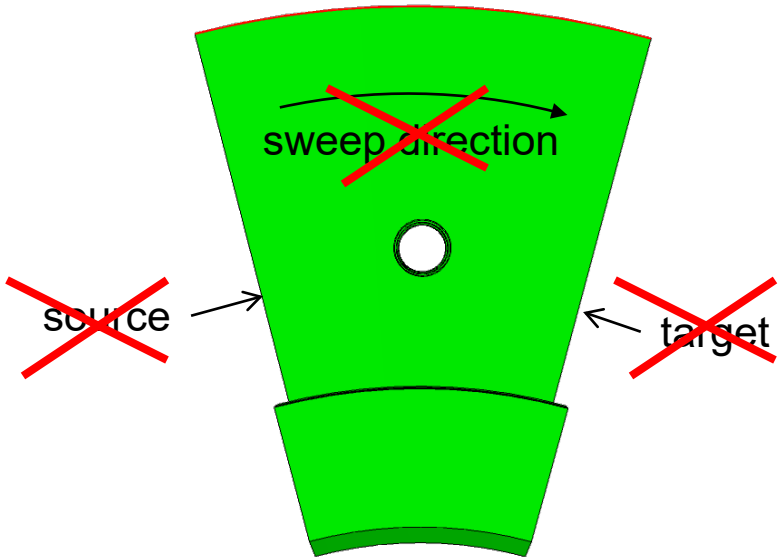


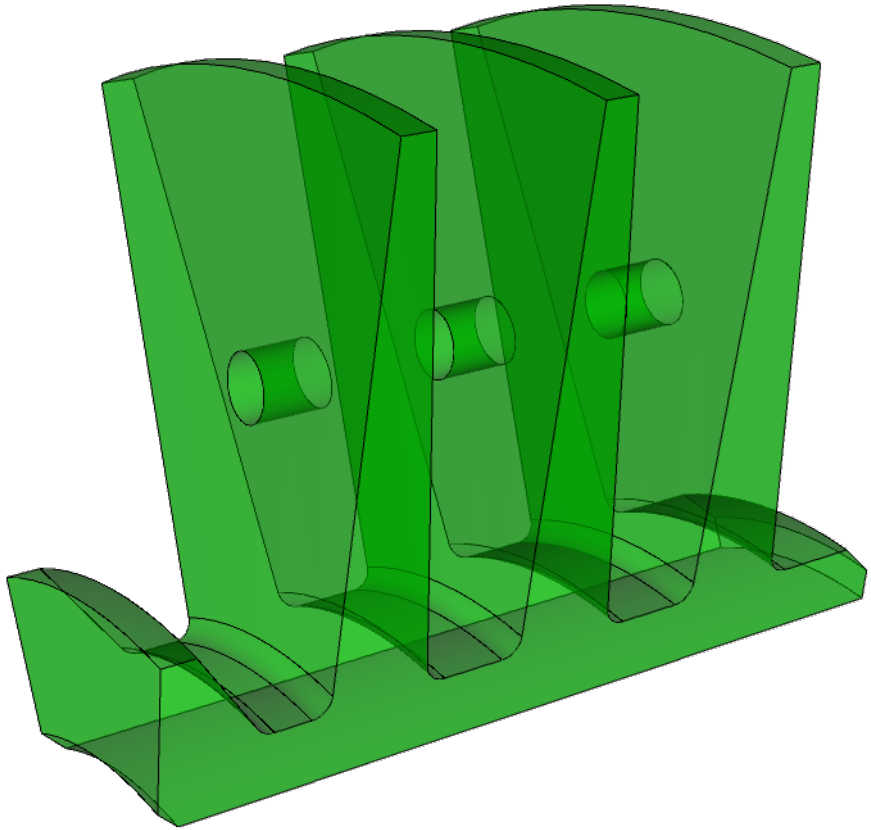


One-to-one sweep

"Easy" to mesh

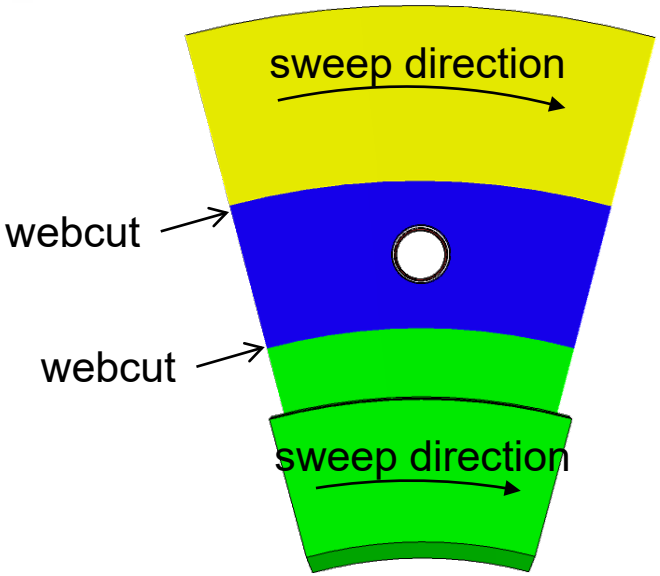
Multiple Sweep Directions



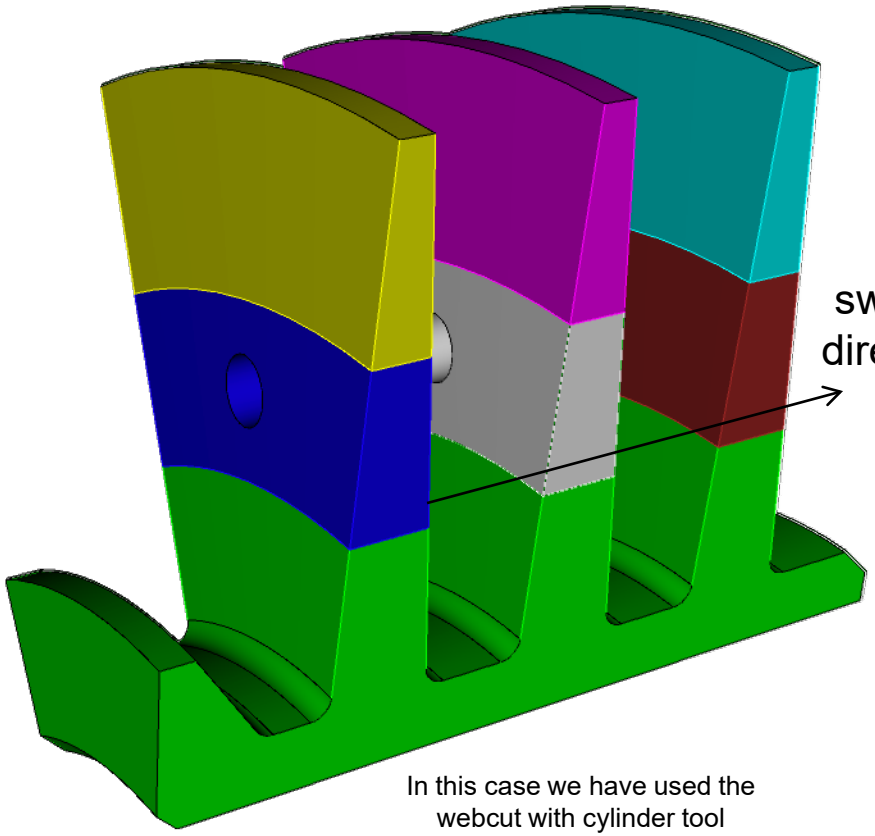


What do we do now?

Multiple Sweep Directions

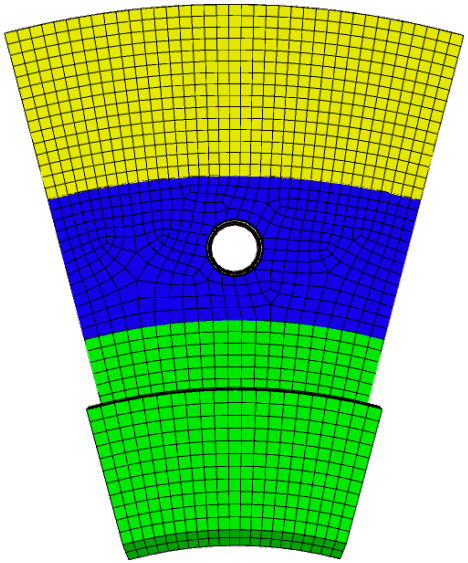


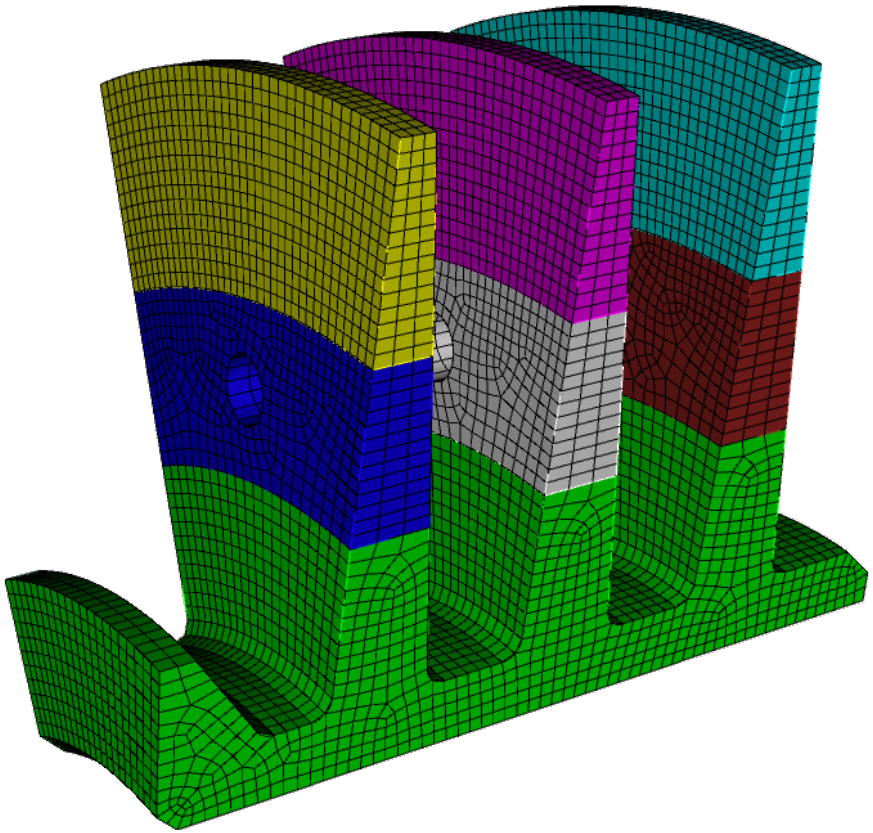
Cut around the feature that is stopping us from sweeping



In this case we have used the webcut with cylinder tool

Multiple Sweep Directions





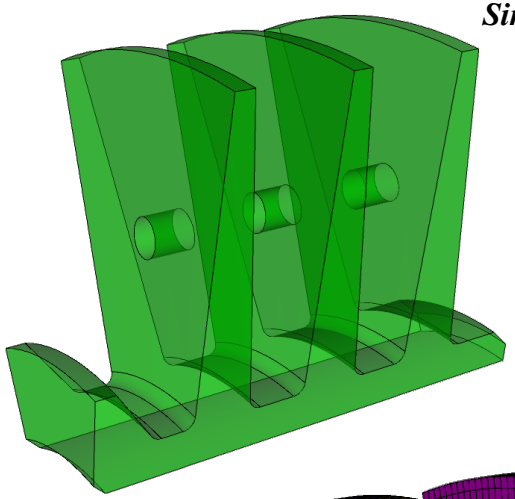
Resulting mesh with 2 sweep directions

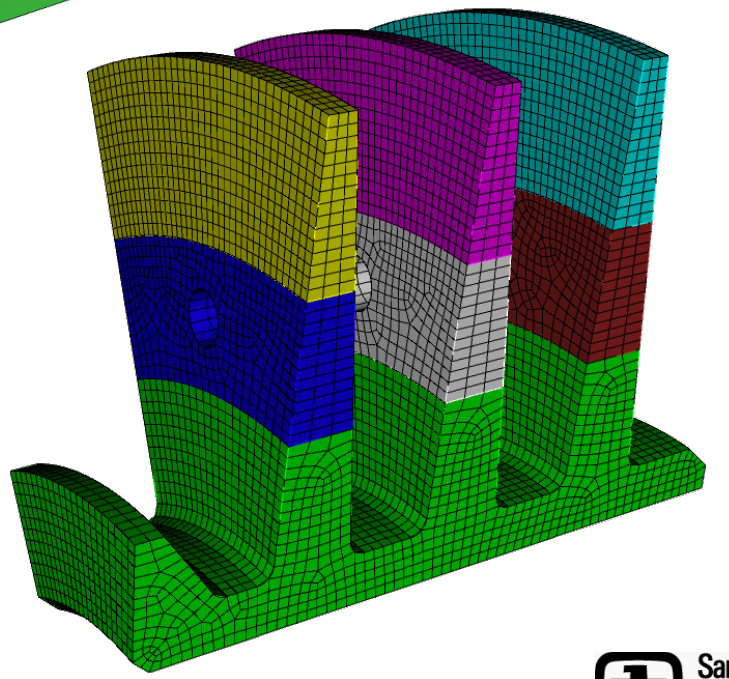
Exercise 1

Import the model “blades.sat”

Generate a mesh with a size of about 2.0

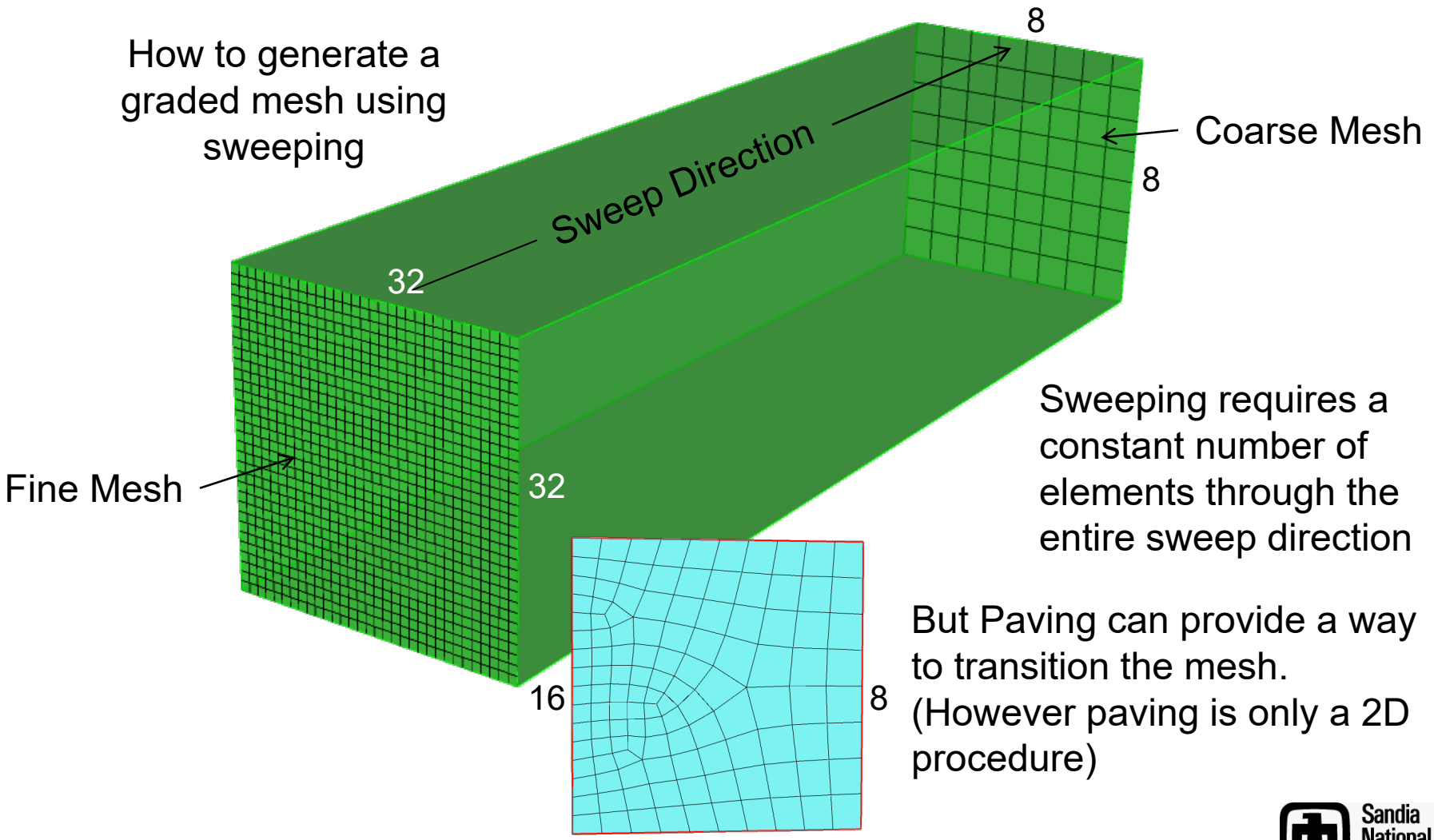
Hint: Use the webcut with cylinder operation to cut out the features that don’t line up with the principal sweep direction





Generating a graded mesh

How to generate a graded mesh using sweeping

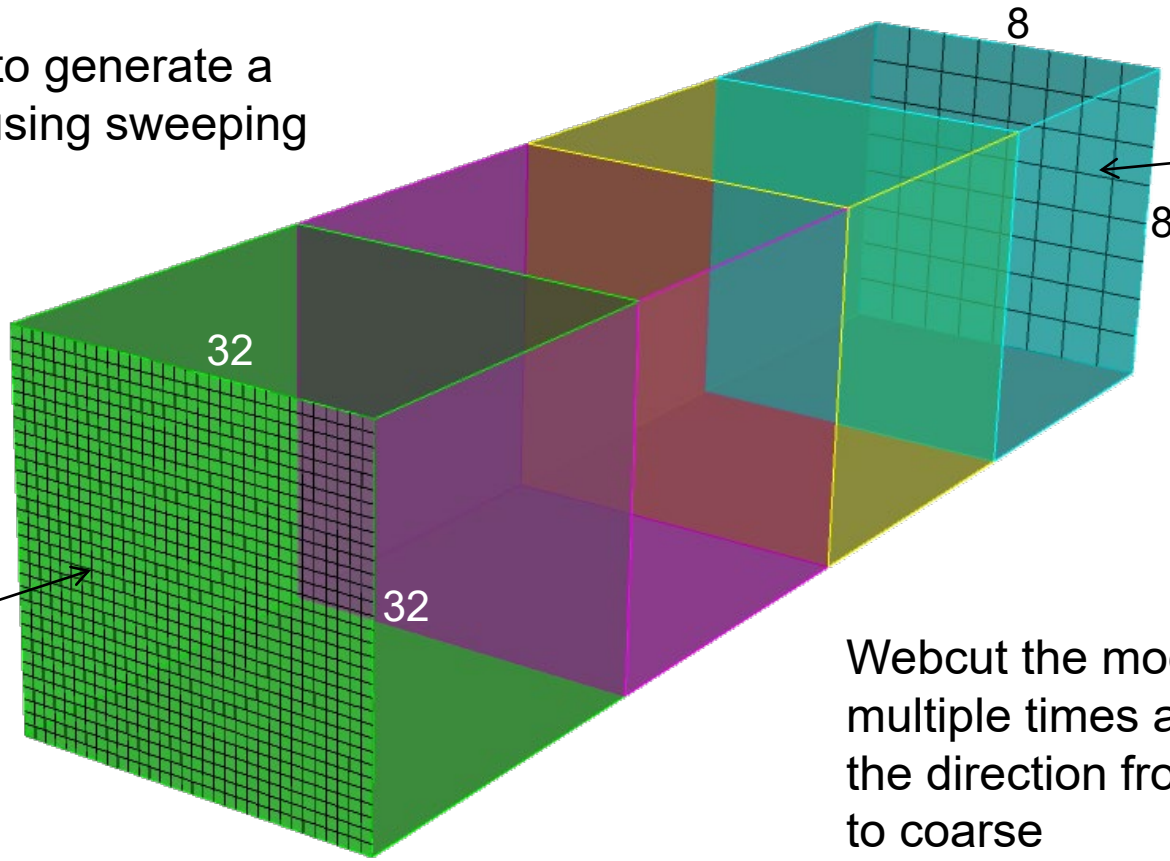


Sweeping requires a constant number of elements through the entire sweep direction

But Paving can provide a way to transition the mesh. (However paving is only a 2D procedure)

Generating a graded mesh

How to generate a mesh using sweeping



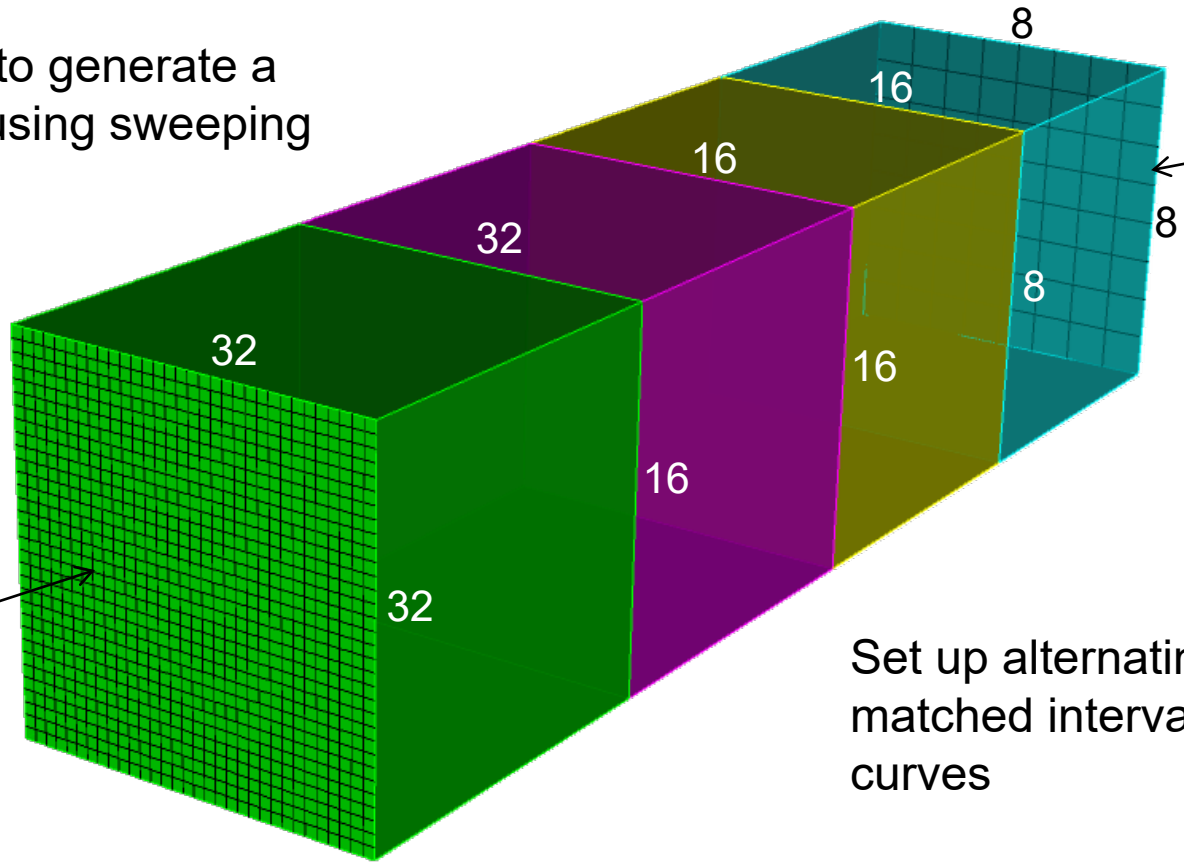
Coarse Mesh

Fine Mesh

Webcut the model multiple times along the direction from fine to coarse

Generating a graded mesh

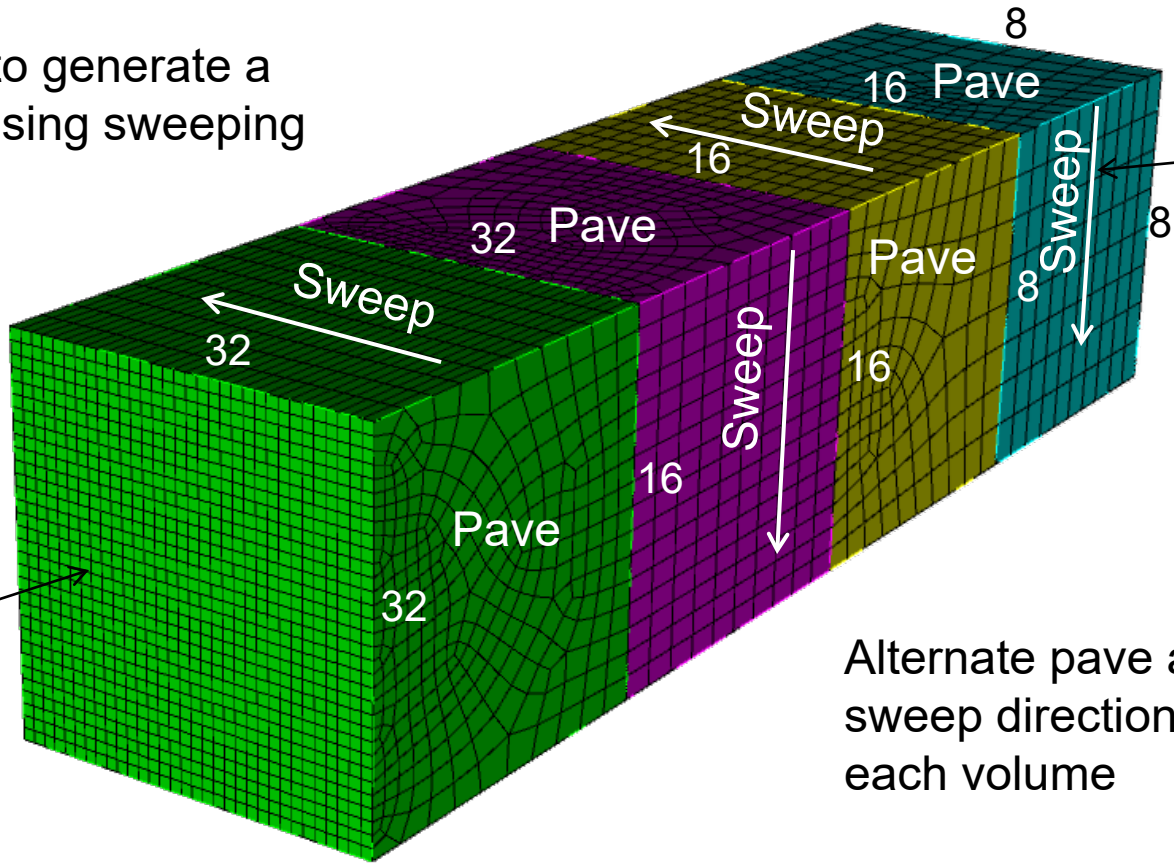
How to generate a mesh using sweeping



Set up alternating matched intervals on curves

Generating a graded mesh

How to generate a mesh using sweeping



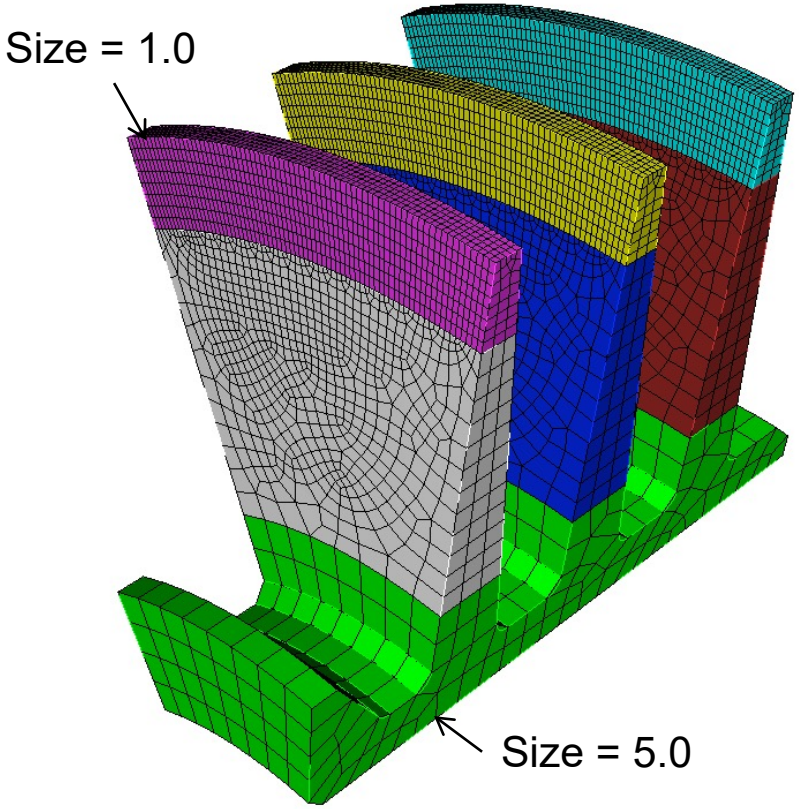
Coarse Mesh

Fine Mesh

Alternate pave and sweep directions in each volume

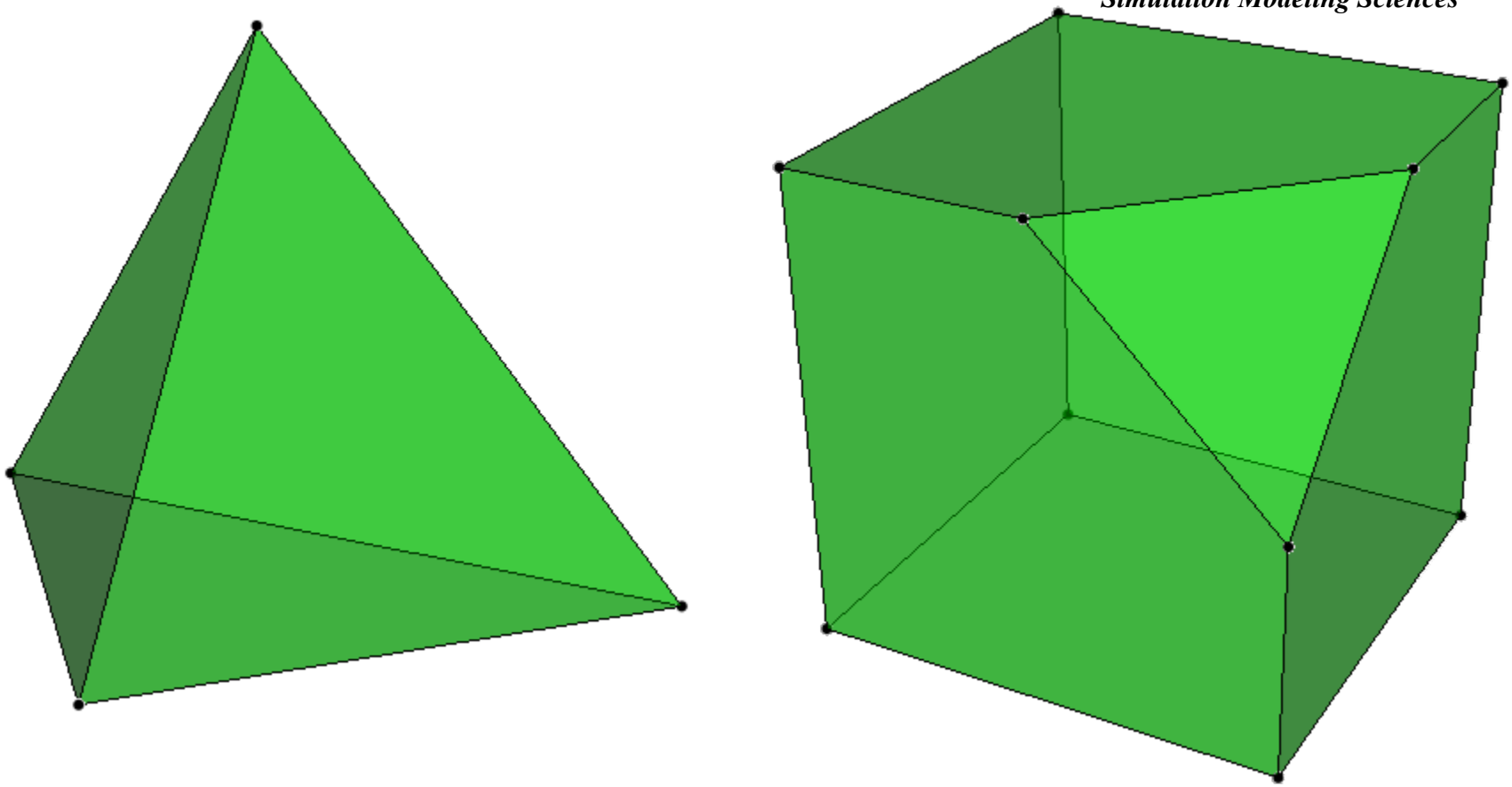
Exercise 2

Import the model “blades0.sat” and generate a graded mesh. Try grading the mesh from a mesh size of 1.0 to 5.0 as shown here



Hints: Use the graded mesh procedure described in the previous slides. Use the webcut with cylinder operation to cut the geometry. Try using the “copy mesh” scheme to avoid having to set up the intervals for each paved mesh.

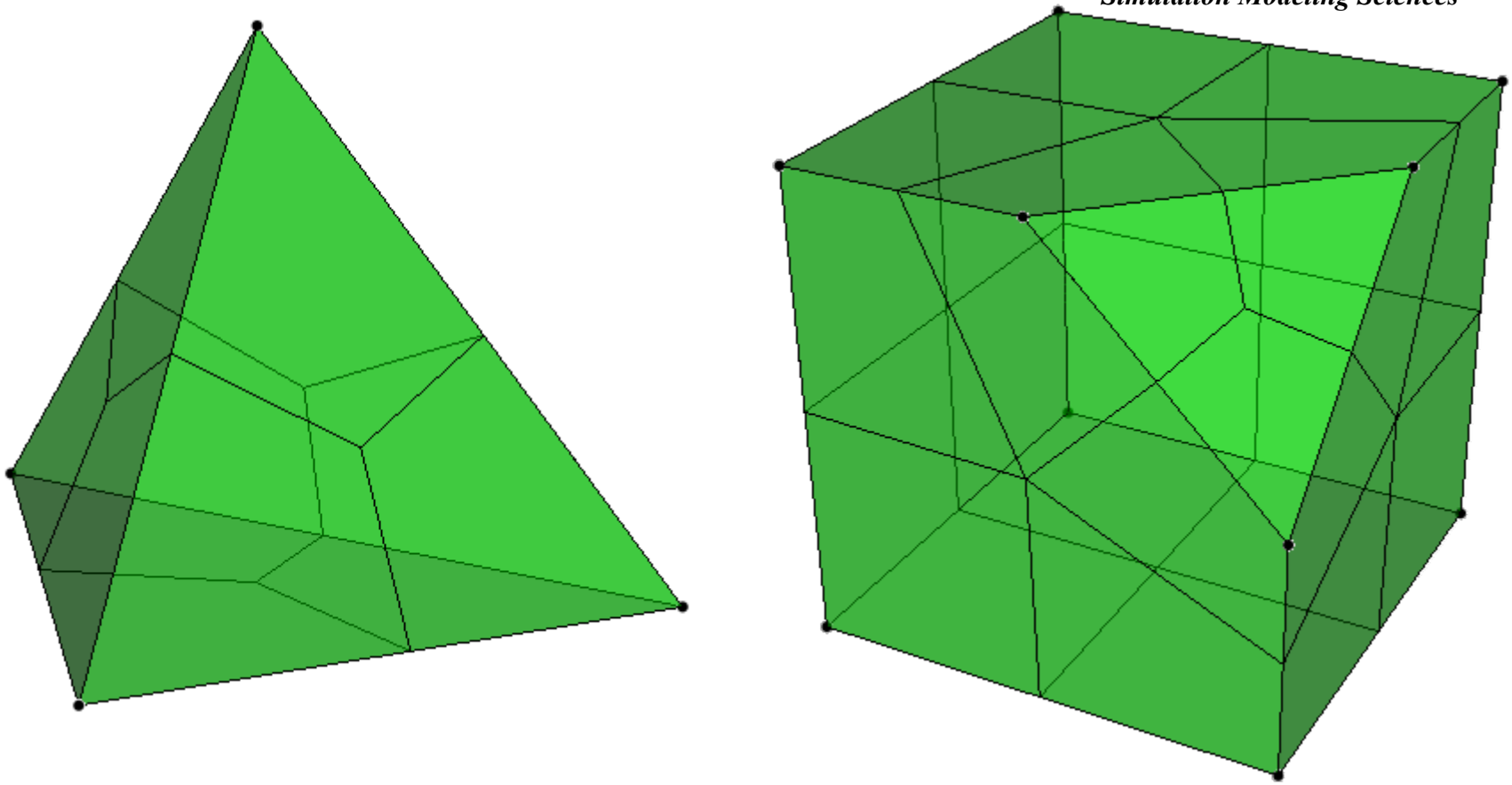
Midpoint subdivision



3D Midpoint subdision

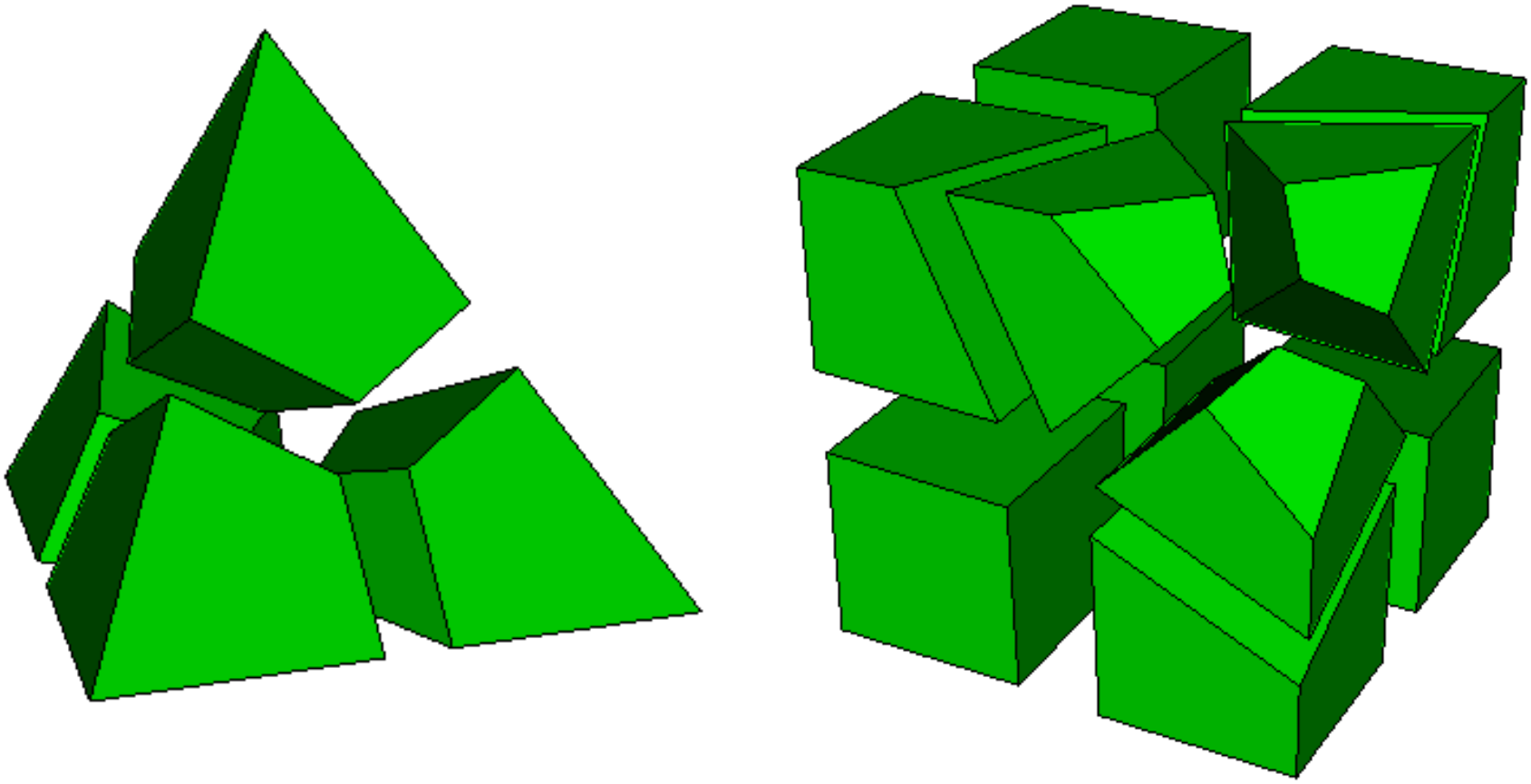
Requires 3-valent vertices and convex polyhedron

Midpoint subdivision



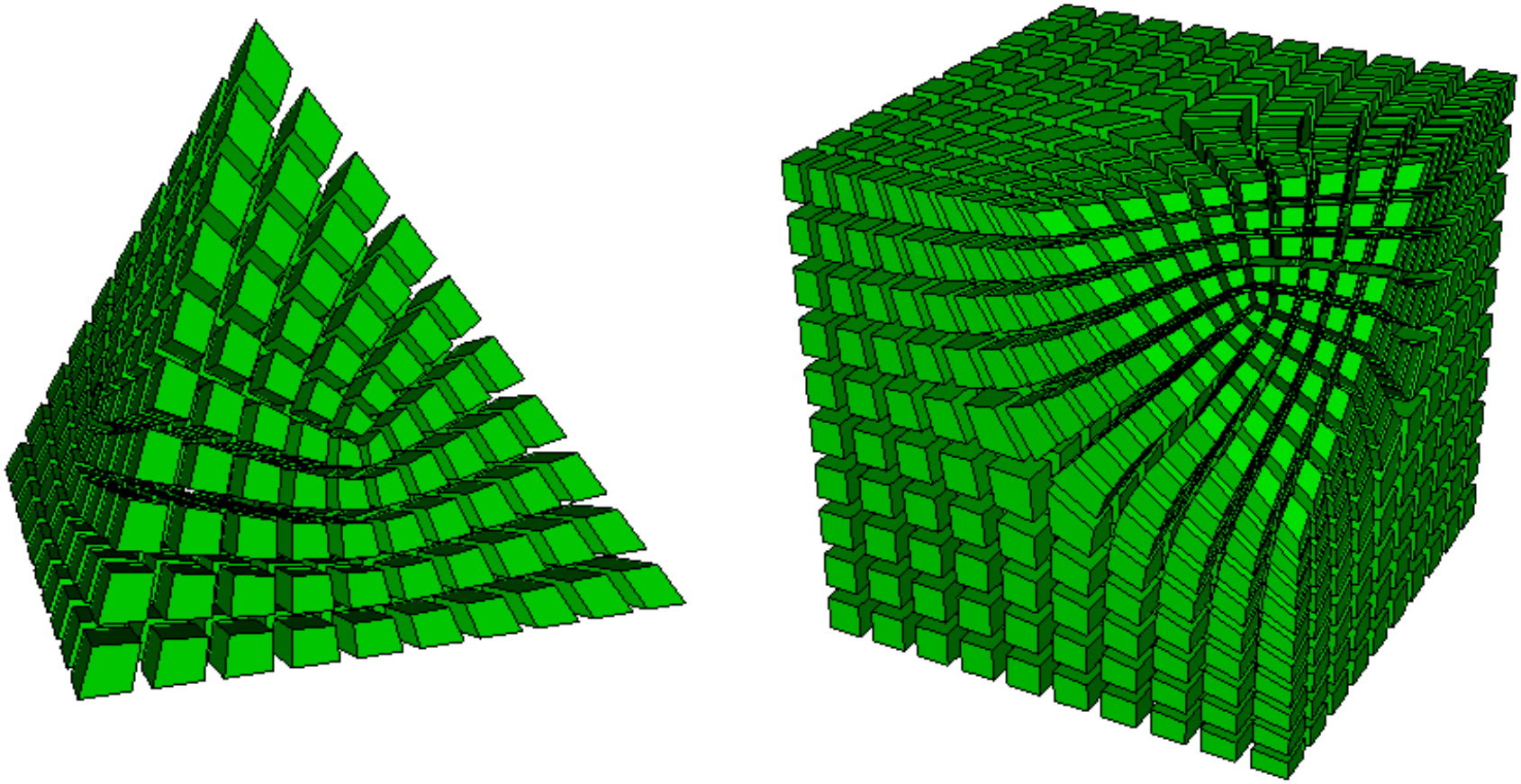
All surfaces must be convex

Midpoint subdivision



Cubit will subdivide the geometry into logical mapped regions

Midpoint subdivision



A mapped mesh will be applied to each logical region

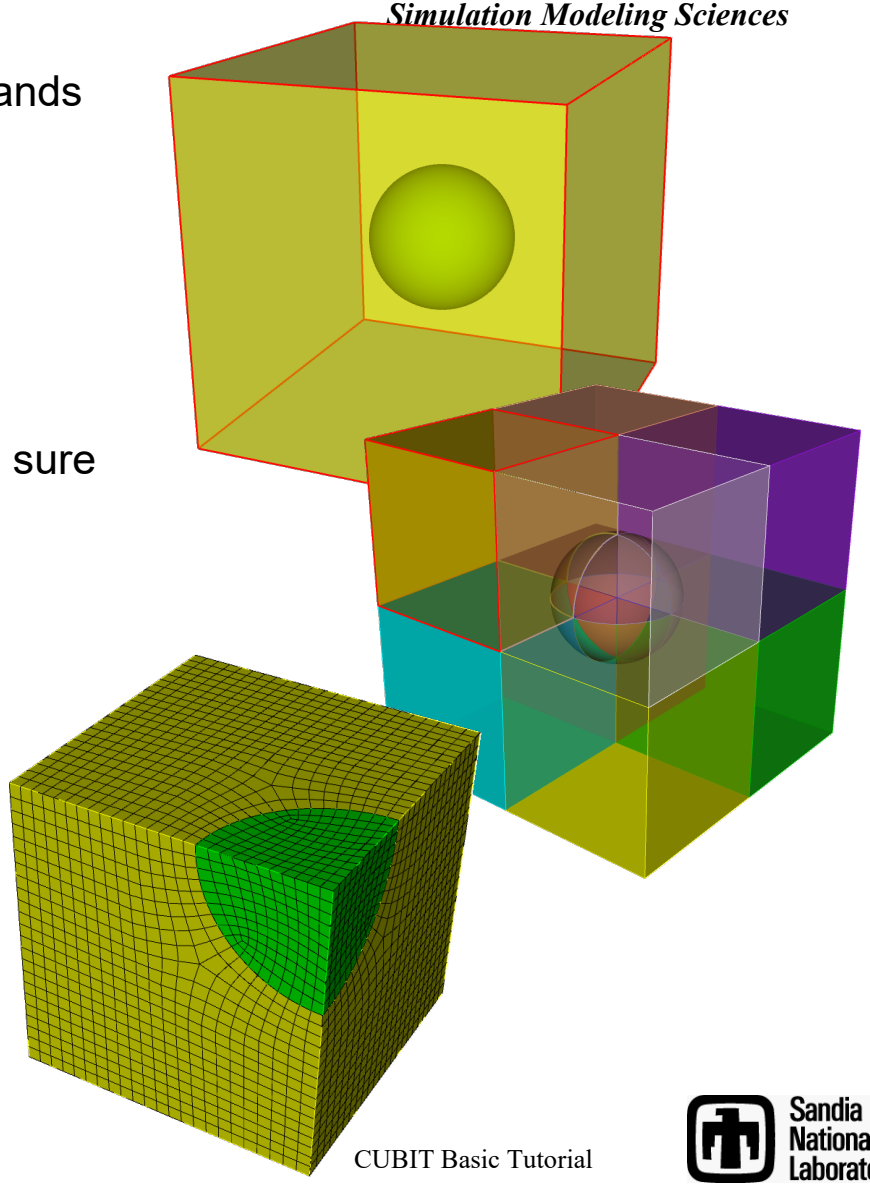
Exercise 3

Create a cubit model using the following commands

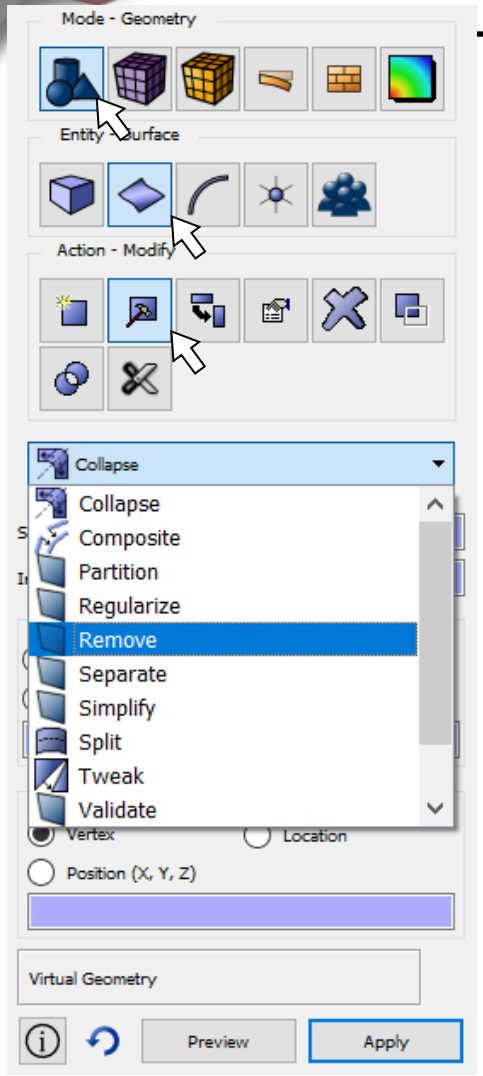
sphere radius 10
brick x 50
subtract vol 1 from vol 2 keep
delete vol 2
compress all

Mesh the two volumes with a size of 1.0. Make sure the mesh matches between the volumes

Hints: Try cutting the volumes on the 3 coordinate axis. This should result in 16 volumes. You should be able to mesh each of the volumes with scheme Polyhedron. You may want to simplify the model and work on one quadrant, and then use copy/reflect for the other quadrants.



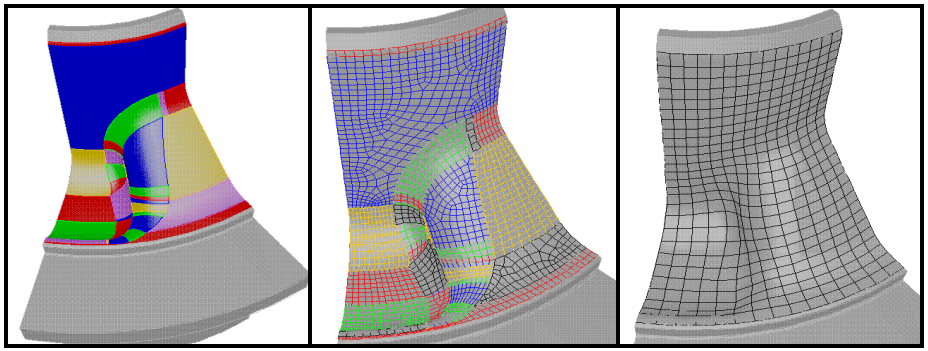
Surface Geometry Tools



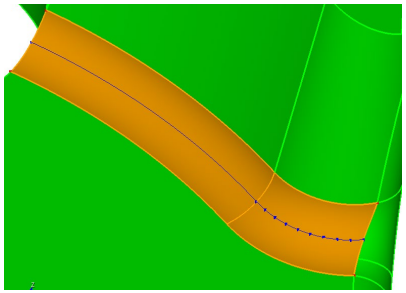
Surface Modify Command Panels

CUBIT includes several tools to modify the surface geometry.

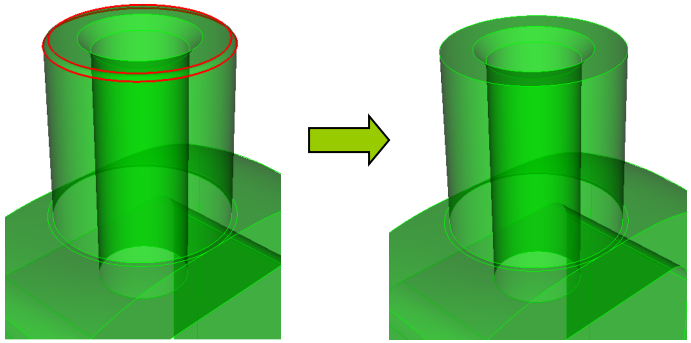
Tools can be used to enforce source-link-target topology for sweeping



Composite surfaces

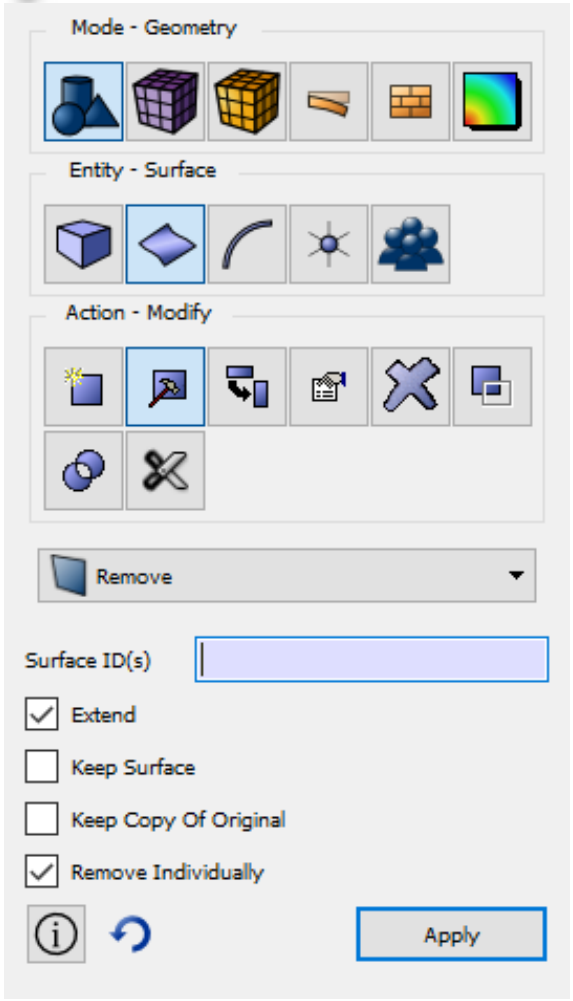


Split surfaces

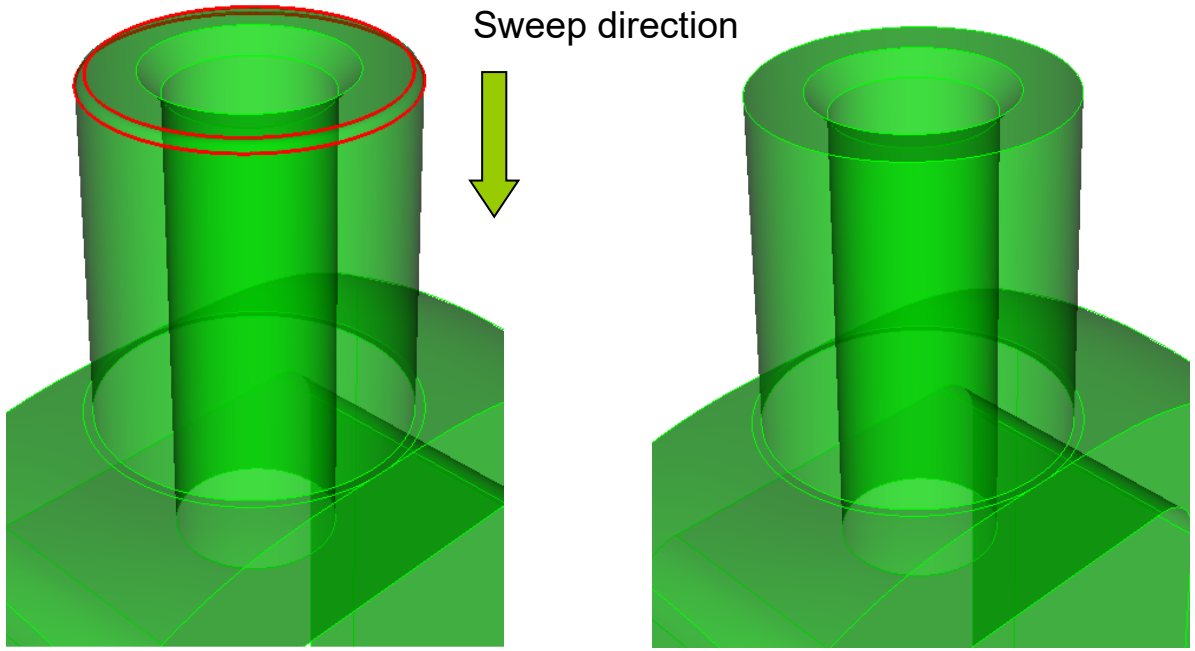


Remove surfaces

Remove Surface

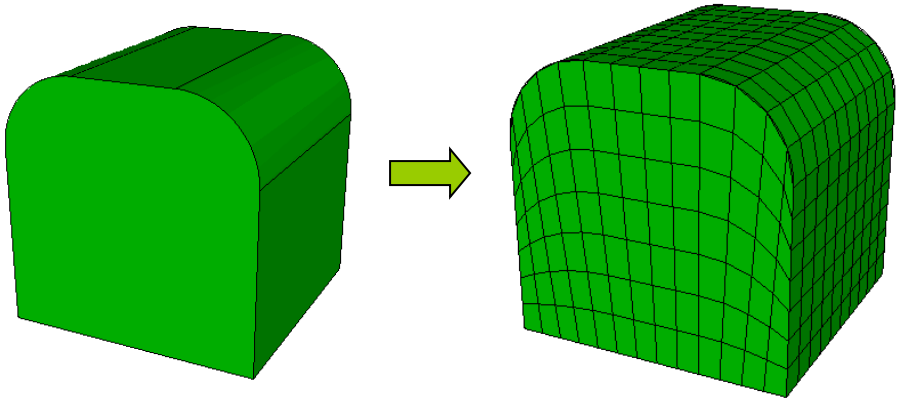


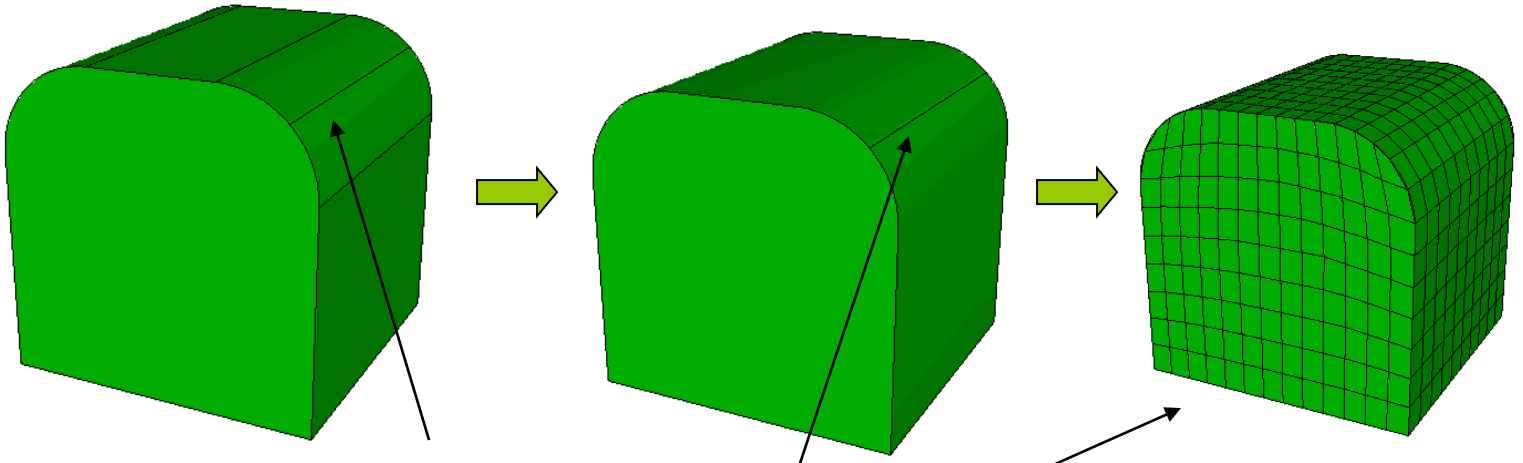
Use CUBIT's **remove surface** command to remove and extend the neighboring surfaces



Splitting Surfaces

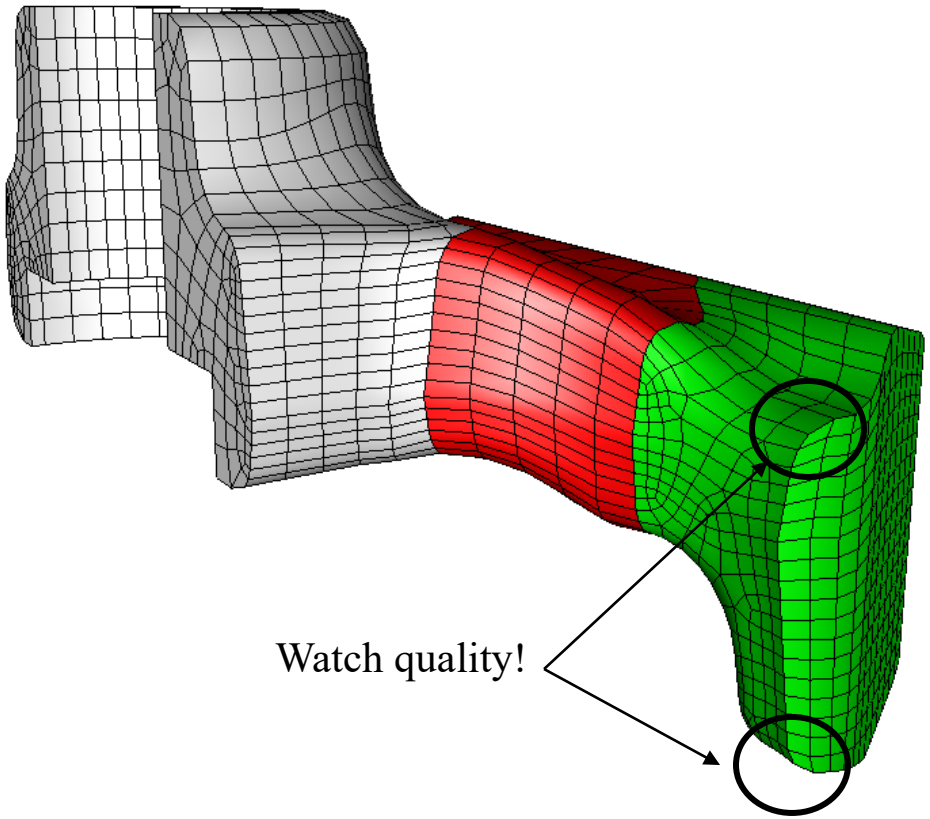
Mesh the existing topology gives a poor quality mesh

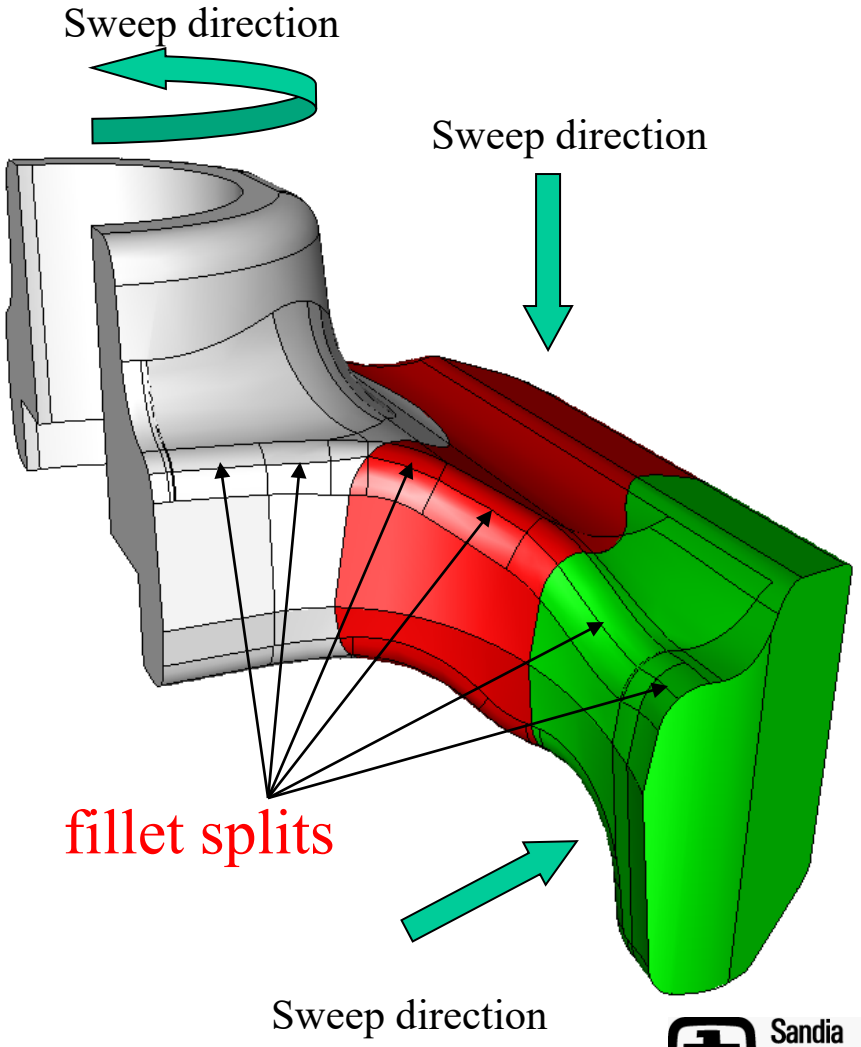




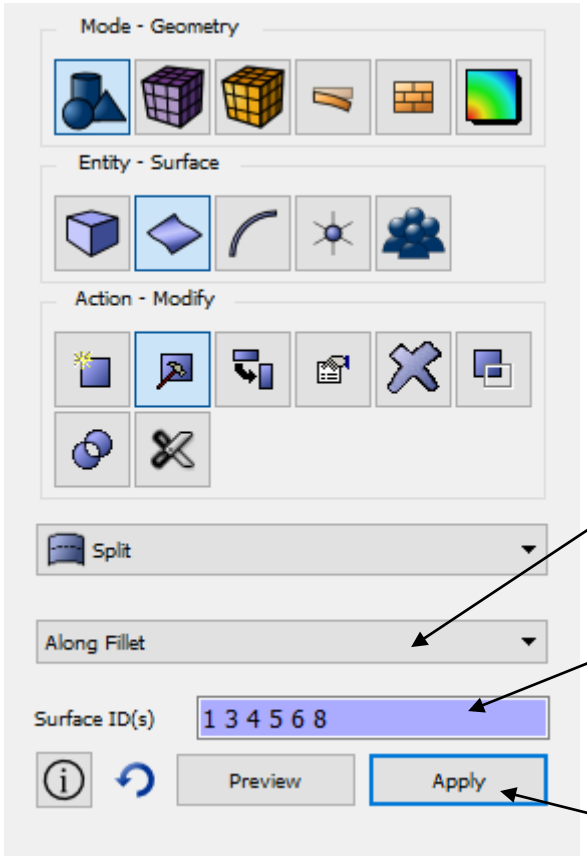
By splitting the surface and then using virtual geometry will result in a higher quality mesh

Split Surfaces





Split Surface

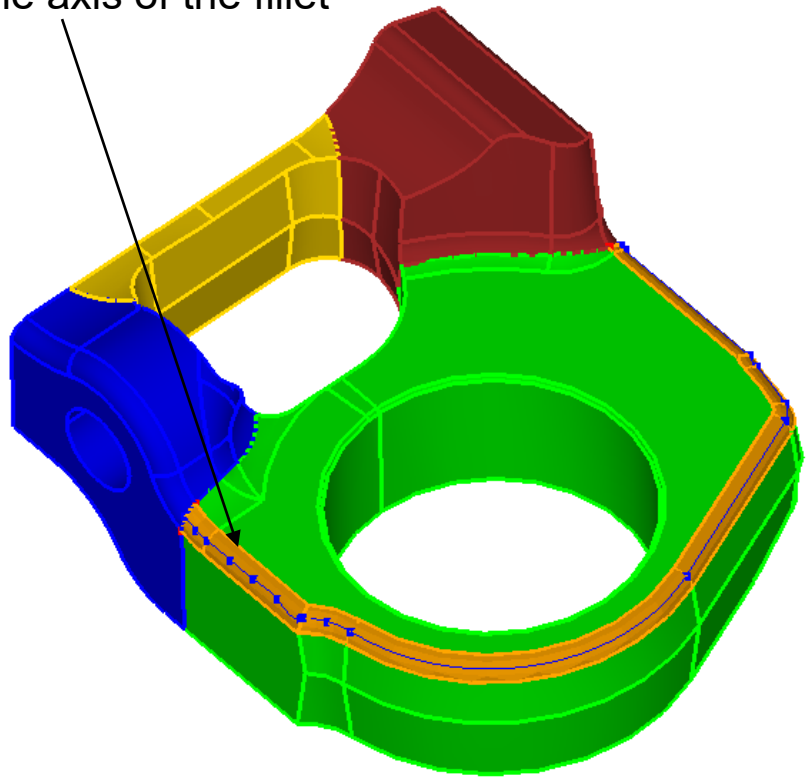


Use CUBIT's **split surface** command to split fillets down the axis of the fillet

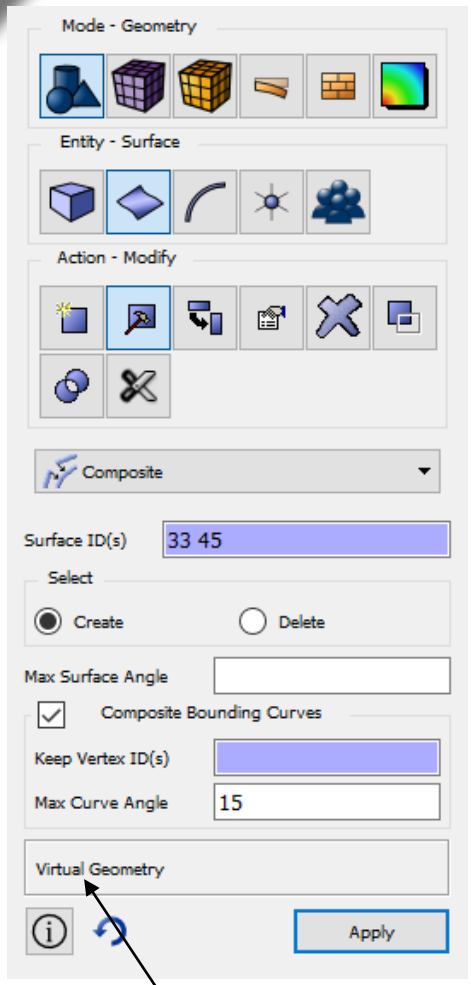
Choose split method (along fillet)

Select surfaces to split

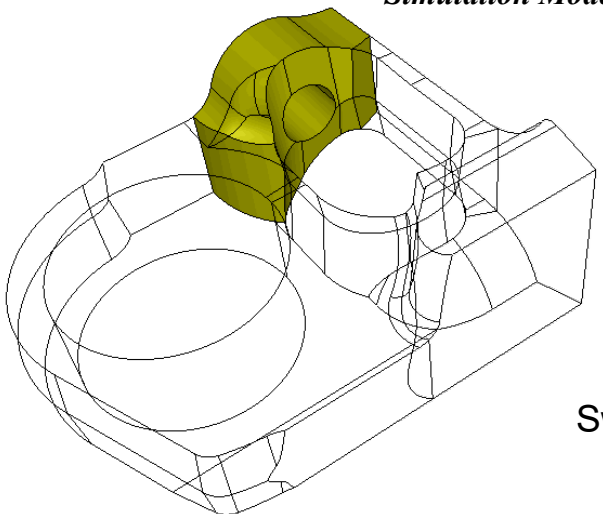
Preview/Apply



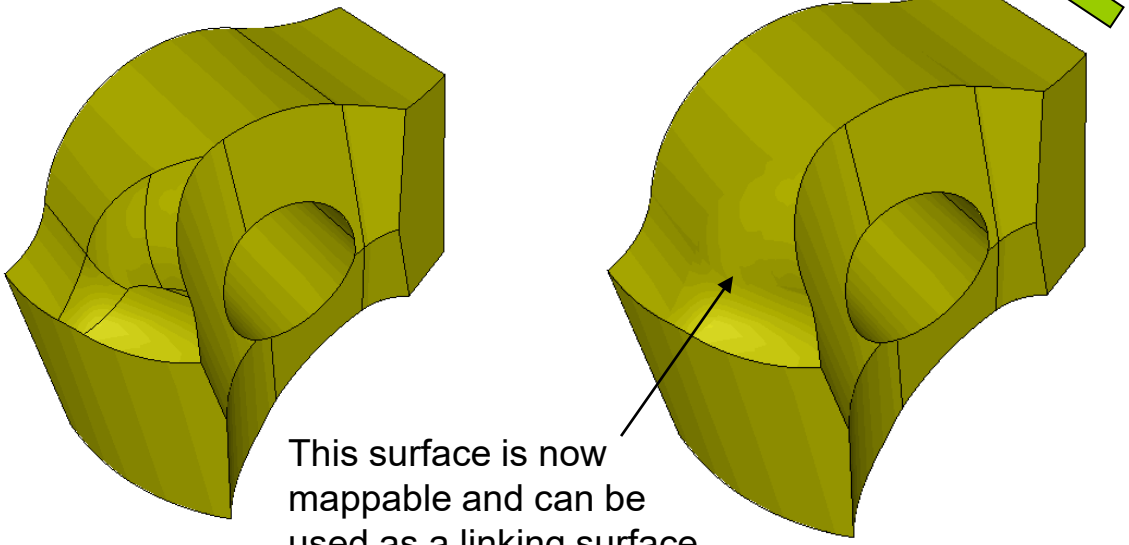
Composite Surfaces



Virtual Geometry is most often used to cover a set of surfaces which normally prevent the volume from being swept.



Sweep direction



Note this is a virtual geometry operation

This surface is now mappable and can be used as a linking surface.

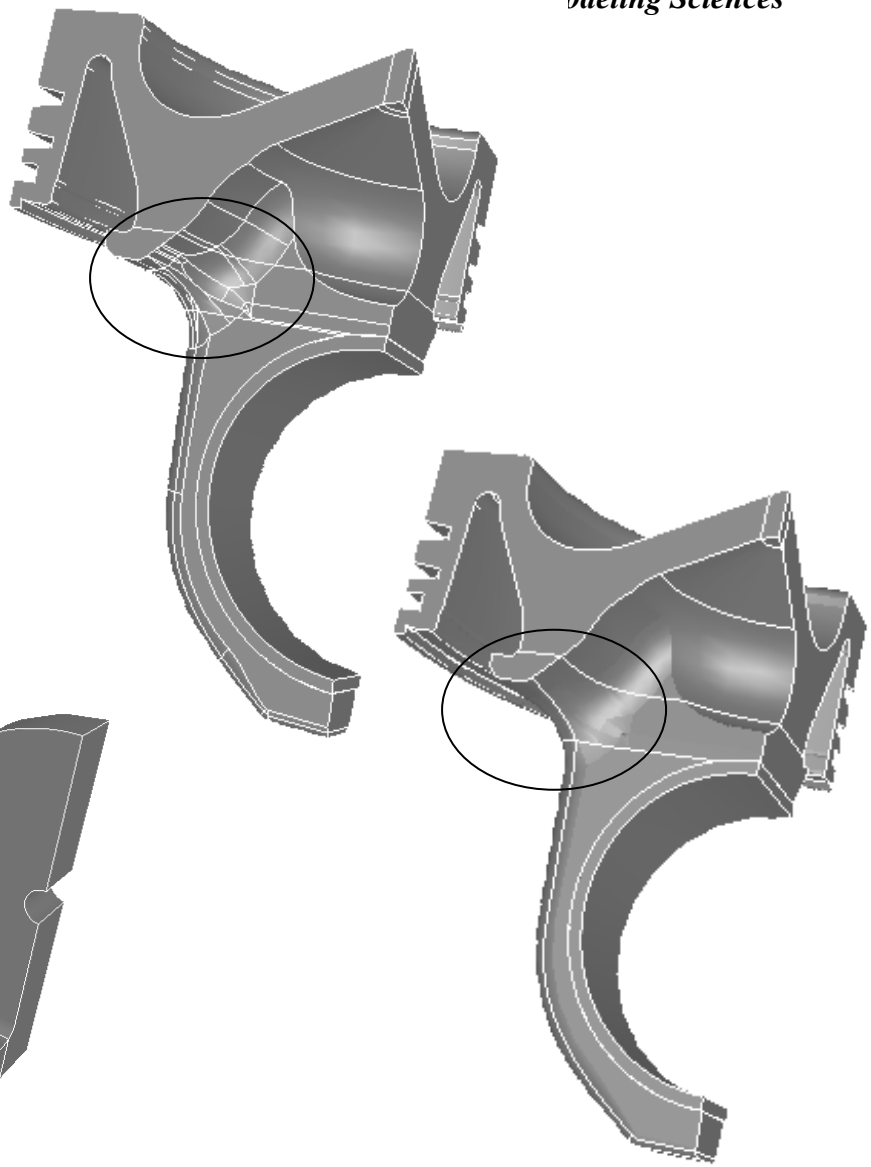
Composite Surfaces

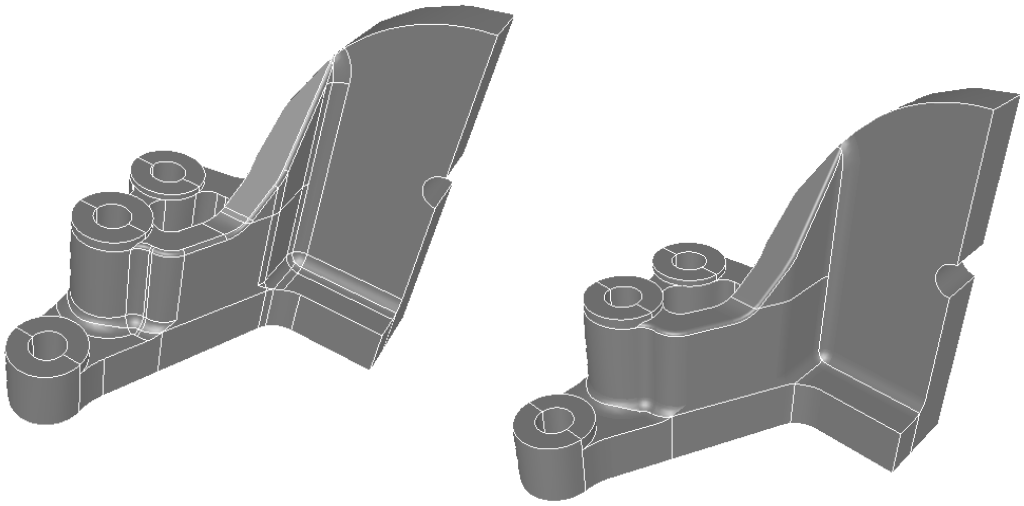
Virtual Geometry is used to cover small surfaces and short curves.

IMPORTANT:

Virtual geometry is not ACIS geometry. It is stored only as an attribute in the .sat file. Also saved in .cub file. Non-cubit applications will not recognize it.

Real operations can be done before or after composite command

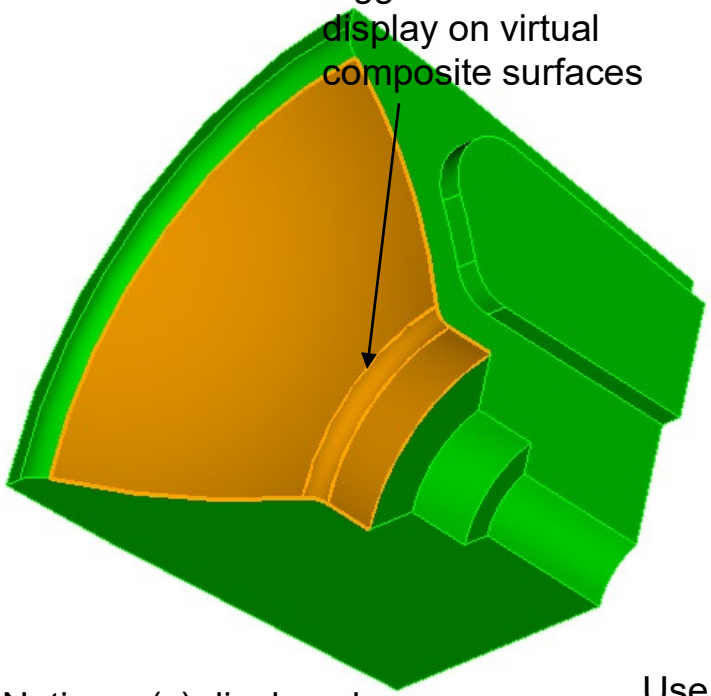


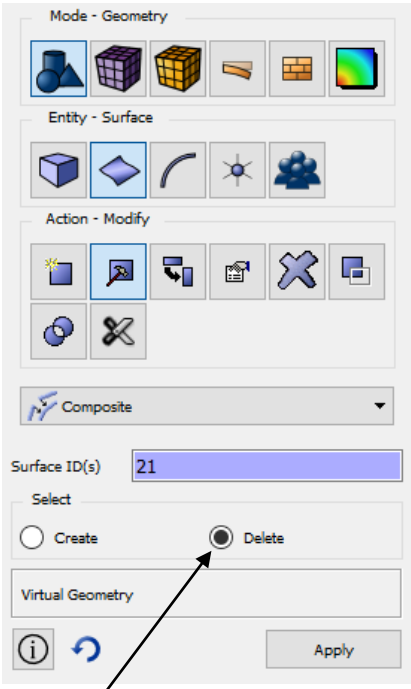


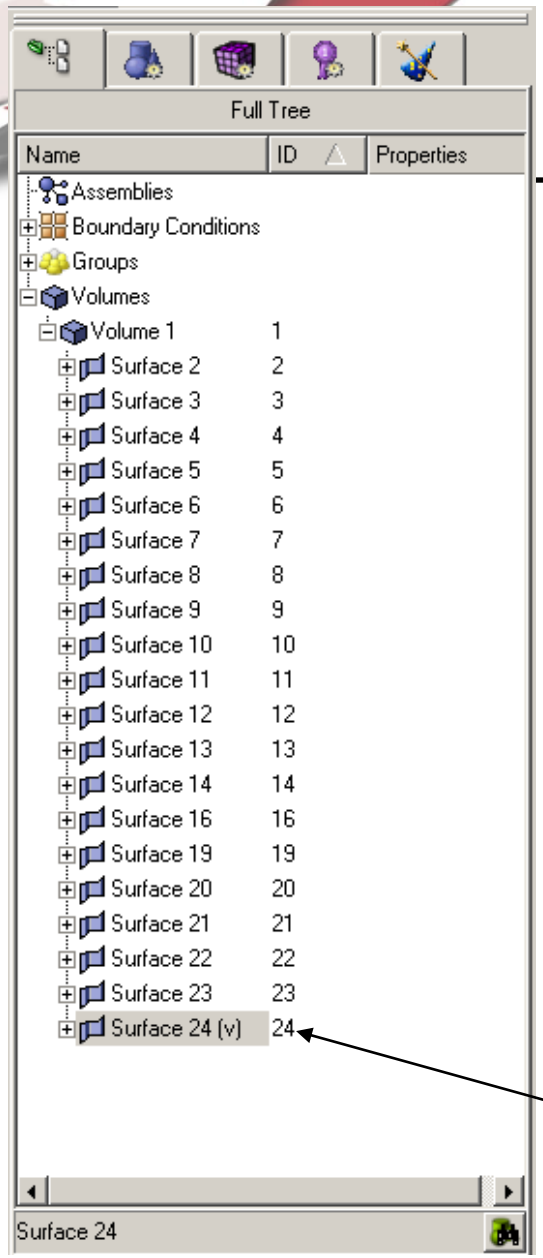
Composite Surfaces

Simulation Modeling Sciences

Use this button to toggle the dotted line display on virtual composite surfaces







Notice a (v) displayed next to virtual surfaces in the model tree

Use Delete toggle to remove virtual

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Exercise 4

Mesh the geometry in the file **Mbracket.sat** with an all-hex mesh.
Use a mesh size of about 0.3

Hints:

Consider surface modification to improve mesh quality. Try split surface and composite operations

Decompostion for sweeping may require multiple sweep directions

At least one of your decomposed volumes should not be sweepable. Try the polyhedron scheme

Even though your topology following split/composite is sweepable, Cubit may not recognize it as such. You may need to explicitly set source and target surfaces.