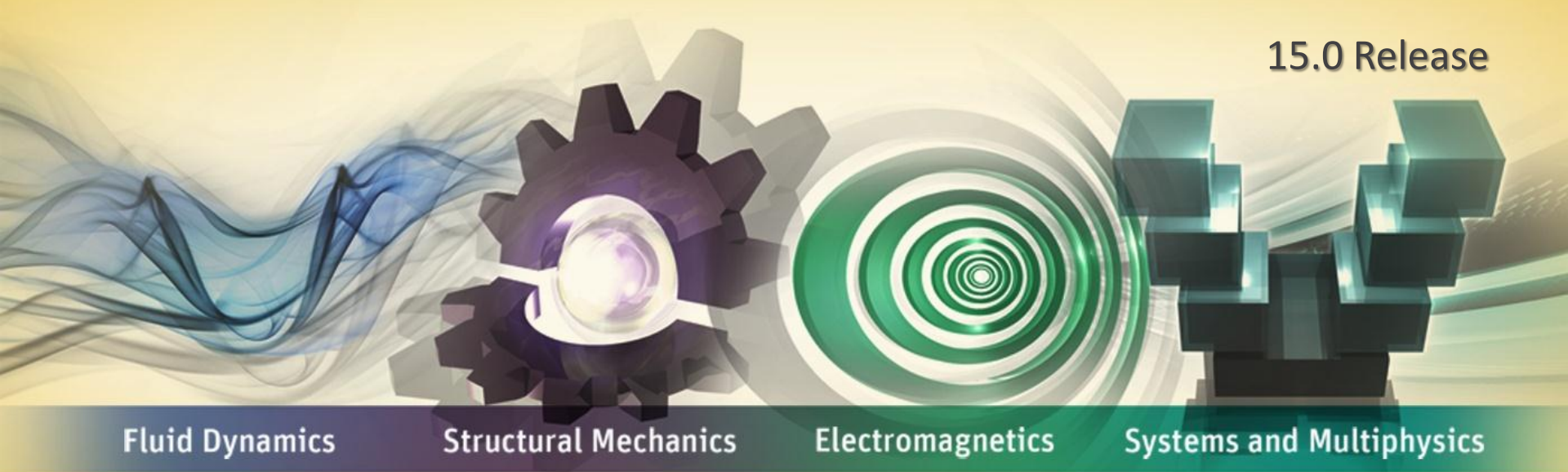


Lecture 2

Geometry Handling

15.0 Release

A horizontal banner with a yellow-to-orange gradient background. It features four distinct 3D visualizations: blue fluid flow lines, a purple gear with a glowing center, a green concentric circle pattern, and a stack of teal cubes. Below these images is a dark teal bar containing four white text labels.

Fluid Dynamics

Structural Mechanics

Electromagnetics

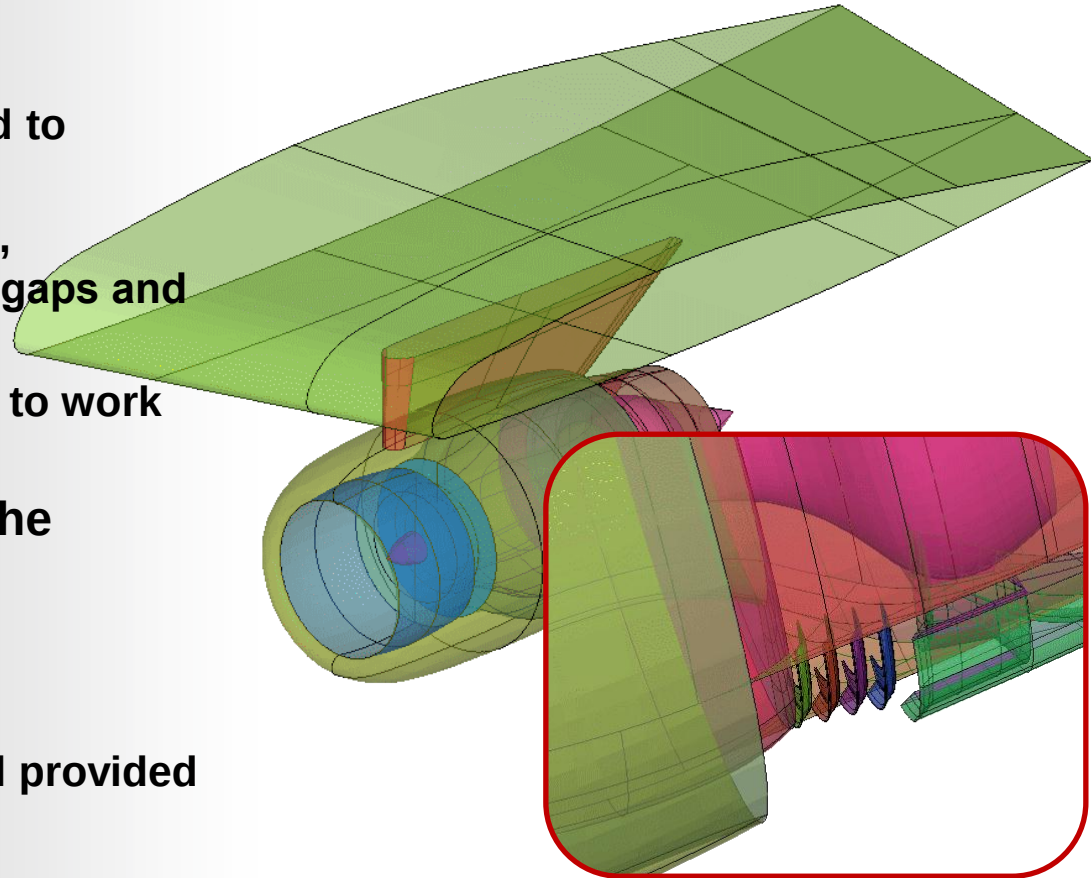
Systems and Multiphysics

Introduction to ANSYS

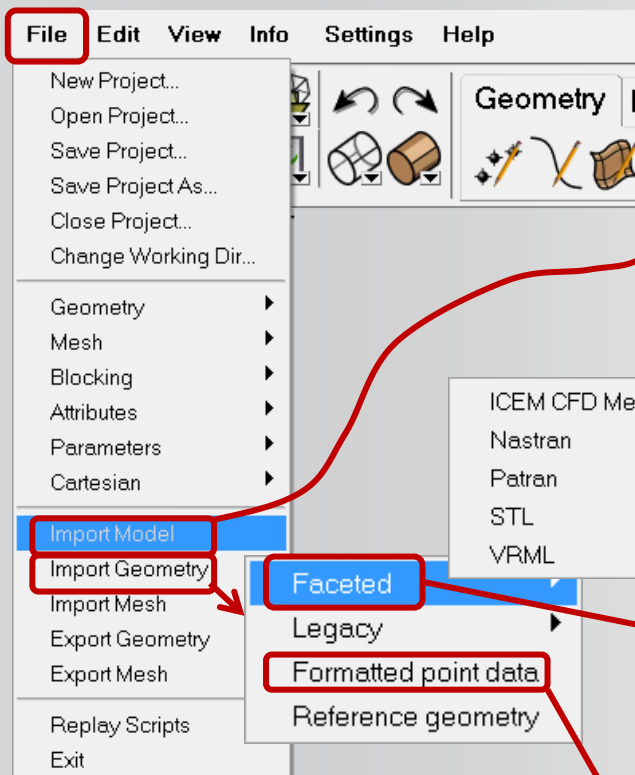
ICEM CFD

ANSYS ICEM CFD was designed to mainly import geometry, not create complicated geometries, although many geometry tools are provided

- **Surface geometry kernel**
 - Imported solids are converted to surfaces
 - Since solids are not enforced, geometry can be “dirty” with gaps and overlaps
 - ICEM CFD meshers are made to work with “dirty” geometry
- **An accurate solution reflects the underlying geometry**
- **Geometry import**
 - Uses Workbench readers
 - ICEM CFD legacy readers still provided
 - Facetted data handling
- **Many internal CAD tools**
 - Geometry creation, modification, fixing



This Jet engine model was built solely with ICEM CFD geometry tools



CAD from just about any source

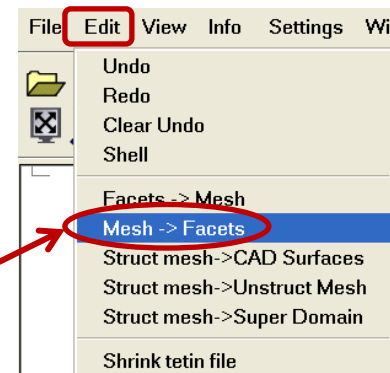
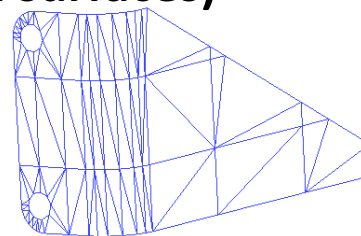
Import Model – uses Workbench readers

- Anything that Workbench can import can also be imported into ICEM CFD

When CAD is not available, an old legacy model or x-ray scan of the part can be imported as geometry. This input is a collection of facets (triangulated surfaces)

Faceted Data

- Nastran
- Patran
- STL (most common)
- VRML
- Other solver formats (indirectly from mesh conversion, after importing mesh)

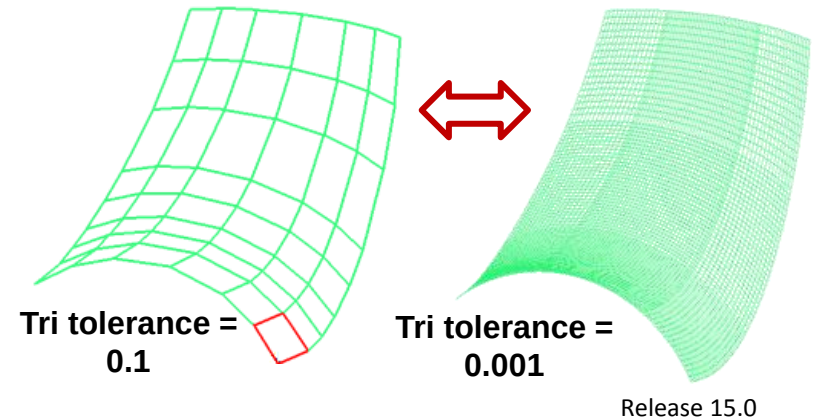
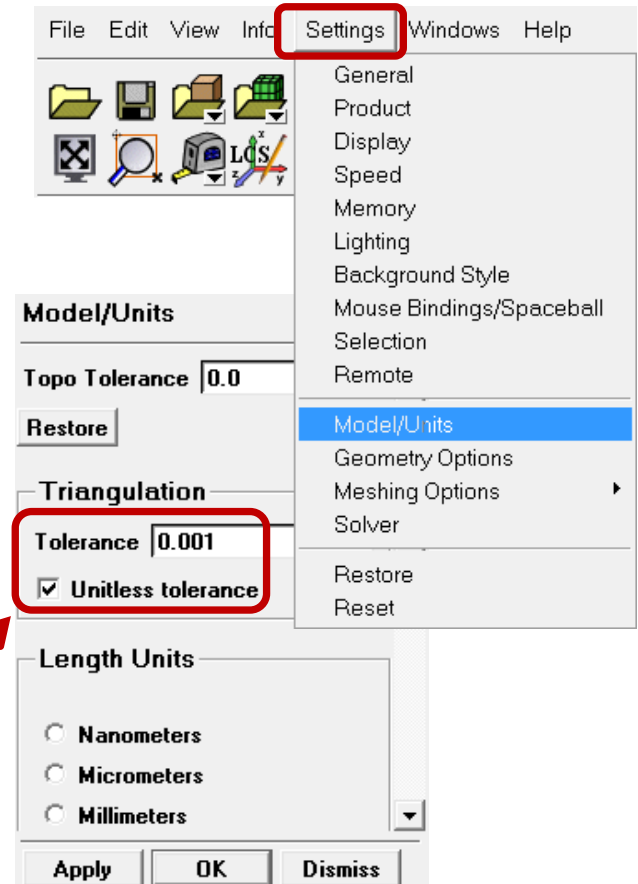


Legacy translators still provided in case the Workbench translator doesn't import the geometry correctly

Formatted Point Data

- Auto curve/surface creation from regular table of points forming ordered U or V curves of a surface

- Geometry saved as “tetin” (*.tin file)
 - Legacy name as an abbreviation of “tetra input.”
 - Surface geometry kernel
 - Any imported solid models are represented as a series of watertight surfaces
 - Surfaces are internally represented as triangulated data
 - Resolution or approximation of true bspline surface data set by **Triangulation Tolerance** in **settings>model**
 - Smaller value = better resolution, curvature
 - 0.001 works best for most models
 - Use a high tri tolerance to work with a large model, but lower the tolerance when it comes time to compute the mesh
 - Not used if surfaces are already facetized (e.g. STL, VRML)



Geometry Creation and Modification Tools

- There are 3 main buttons to create and modify geometry – each of these has its own menu with multiple functions

-  – Create Point
-  – Create/Modify Curve
-  – Create /Modify Surface

Geometry

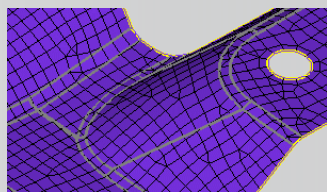
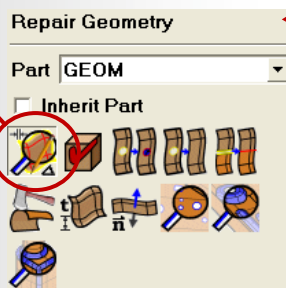
Delete point, curve, surface, body



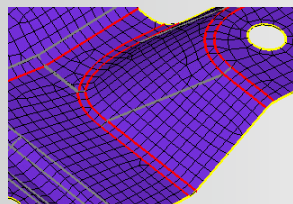
- Repair Geometry** menu also has geometry functions



- Build Diagnostic Topology**
- Stitch/match edges
- Close/remove holes



Dormant curves



Build topology with filtering

Transformation tools

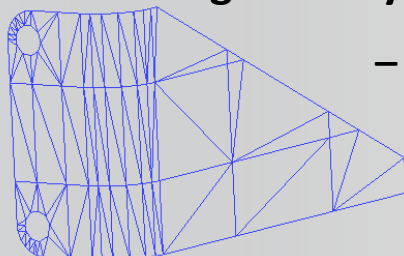


Translate, rotate, mirror, scale

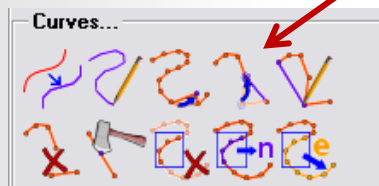
Facetted geometry tools



Facetted geometry tools



- Facetted surfaces are made of triangles



Facetted curves



Facetted surface tools

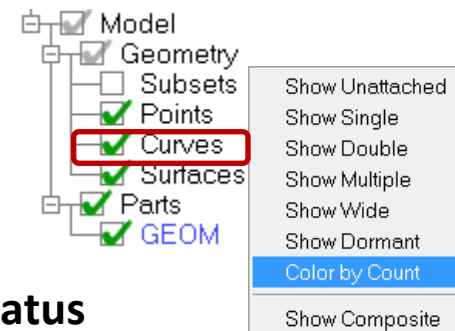


Facetted modify tools



- Shows potential leakage (tetra octree) before meshing
- Shows where surface mesh may not be connected
- Patch dependent surface mesher requires build topology
- **Tolerance**
 - Specifies allowable gap between surfaces
 - Size should be set big enough to ignore small gaps, but not too big to ignore leakage (tetra octree) or remove important features
 - Default is $1/2500^{\text{th}}$ of the diagonal of the bounding box
 - Connectivity is set up between surface edges that meet within the tolerance
 - Filtering should be off when using to determine connectivity

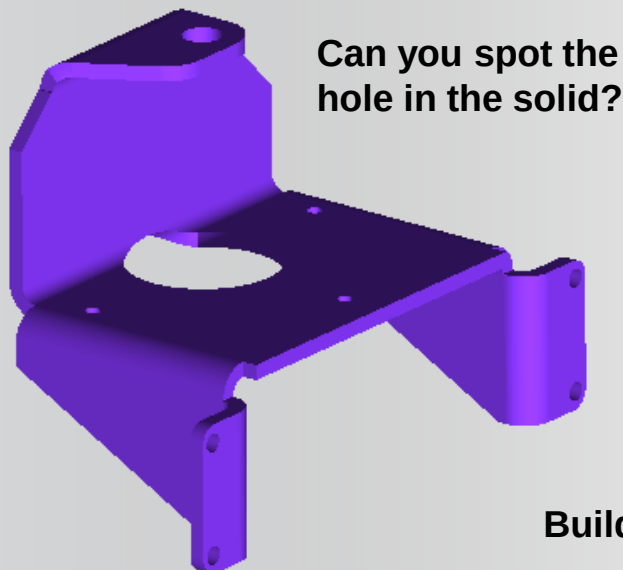




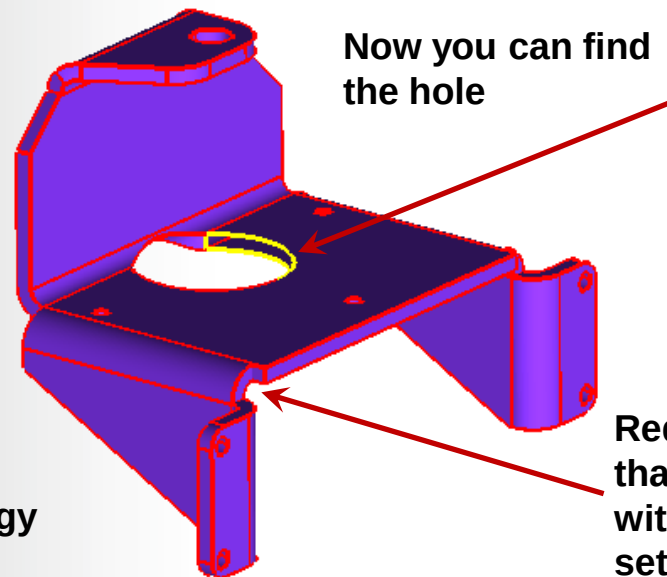
Color coding

Topology curves are color coded to indicate their surface connection status

- **green** = unconnected, **yellow** = single, **red** = double, **blue** = multiple, **Grey** = dormant (filtered out)
- Turn color coding off/on in **Model tree > Geometry > Curves > Color by count**
- **Red curves** indicate two surfaces meet within the tolerance, This is what you want for a solid model.
- **Yellow curves** will usually indicate some repair is required



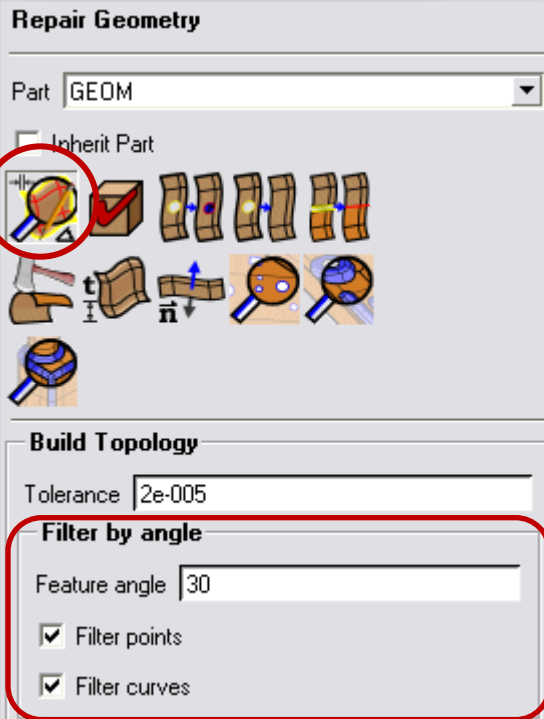
Build Topology



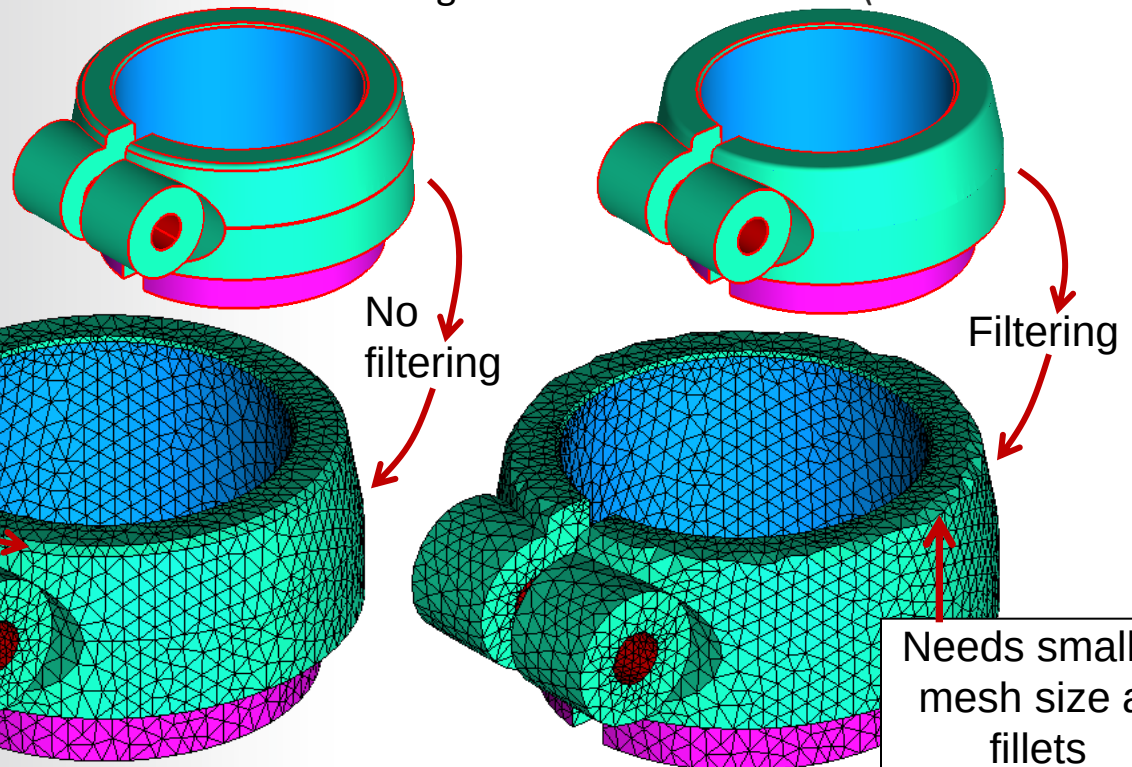
Yellow curves indicate that the surface is probably missing or the gap is greater than the tolerance

Red curves indicate that surfaces meet within the tolerance setting

Build Topology – Extract Curves and Points



- Automatically extracts curves and points from the surfaces
- **Filter by angle** (default 30 degrees)
 - **Filter Points:** Points between two curves whose tangency is below the feature angle will be “filtered out” (made dormant)
 - **Filter Curves:** Curves between two surfaces whose tangency is below the feature angle will be “filtered out” (made dormant)

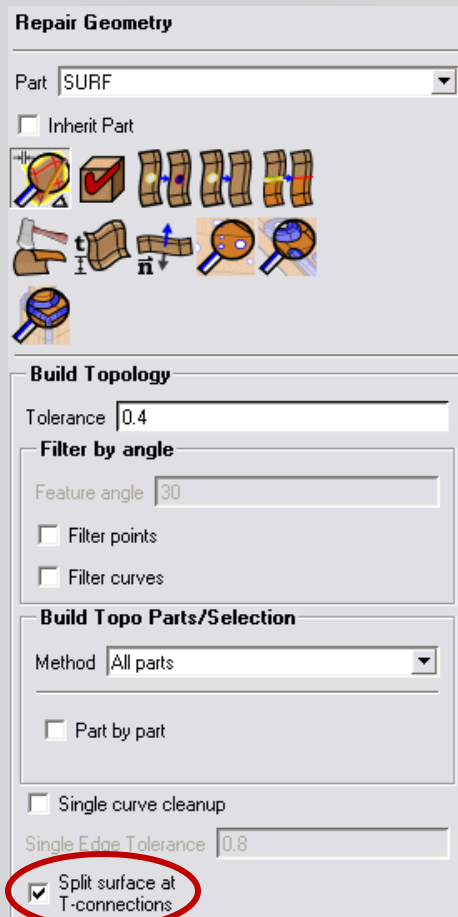


Needs smaller
mesh size at
fillets

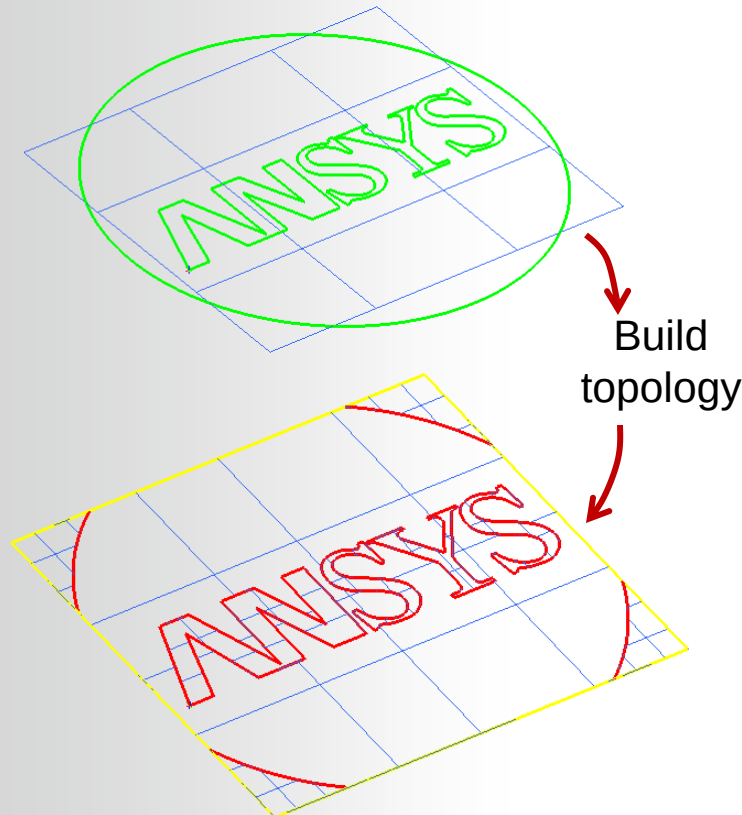
Tetra octree and
patch dependent
surface mesher
enforce nodes on the
curves

Build Topology – Segment Surfaces

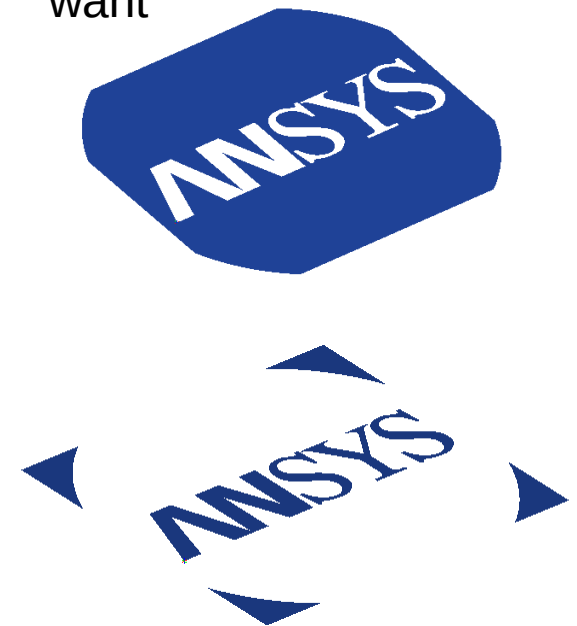
- Automatically segments all surfaces where curves either make a complete loop on the surface or span across the surface
- Turn **Split surface at T-connections** off to turn off segmenting



Check off to disable segmenting



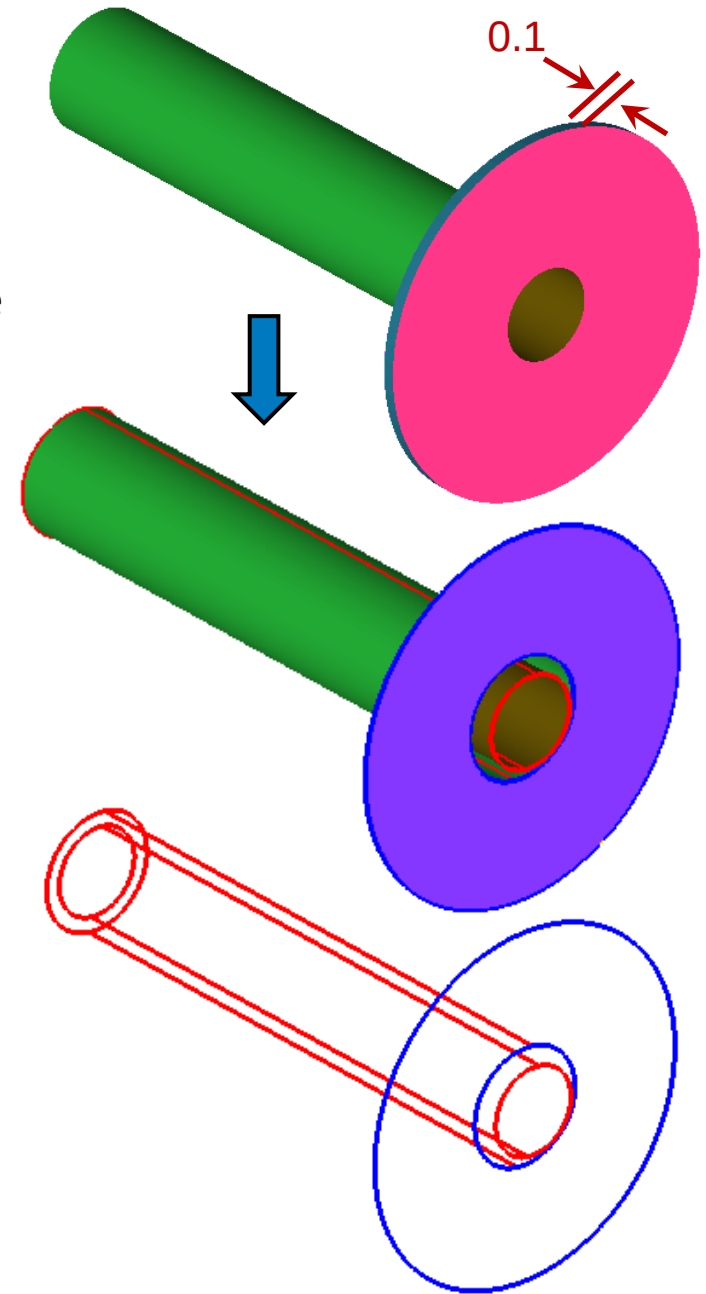
You can then delete any surfaces you don't want



Tolerance setting

Set adequate tolerance!

- Example: some multiple (blue) edges. This indicates that more than two surfaces meet within the tolerance setting
- Turning on the surfaces reveals one surface is now missing.
- In this case, the tolerance (0.2) was set to greater than the thickness (0.1). One of the surfaces was seen as a “duplicate” within the tolerance and removed. UNDO
- *You will need to exercise care not to damage your model with build topology*
 - Too small is safer but indicates more gaps
 - Too big can alter the model in bad ways
- Rule of thumb: tolerance should be about $1/10^{\text{th}}$ smallest foreseen mesh size or smallest feature that you wish to capture
- *Build topology will delete duplicate geometry because its tolerance is zero*



Workshop 2.1

Engine Part

- Build topology
- Retrim surfaces
- Match surfaces
- Fill gaps
- Close holes
- Remove holes
- Extruded surface
- Delete unattached

