SAND2008-6531C

Computational Modeling Sciences Department

Conformal Assembly Meshing with Tolerant Imprinting

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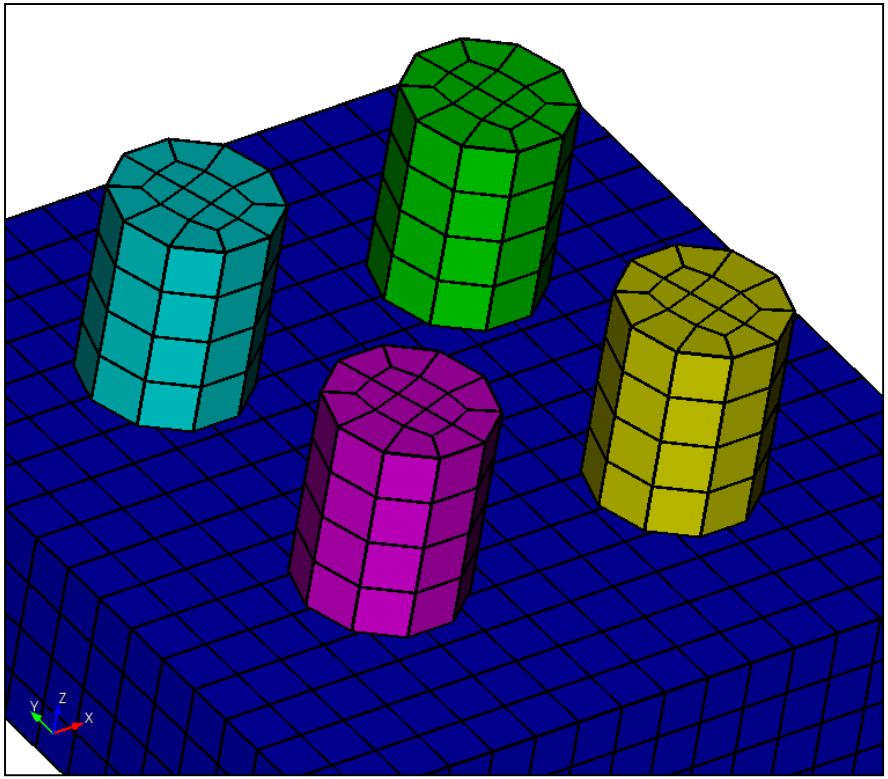
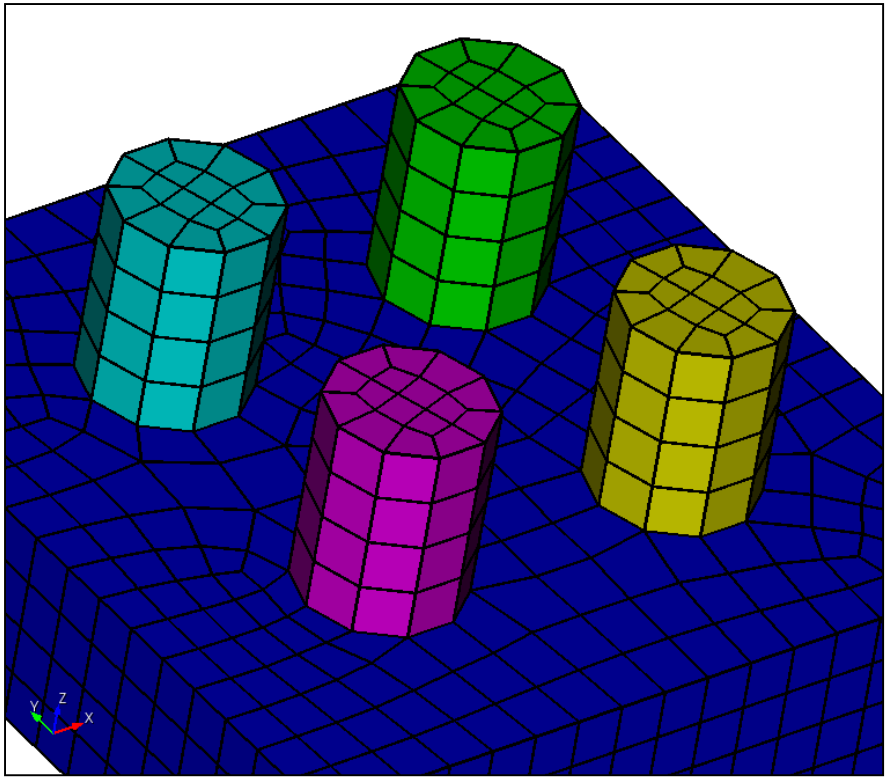
International Meshing Roundtable 2008

Conformal Assembly Meshing

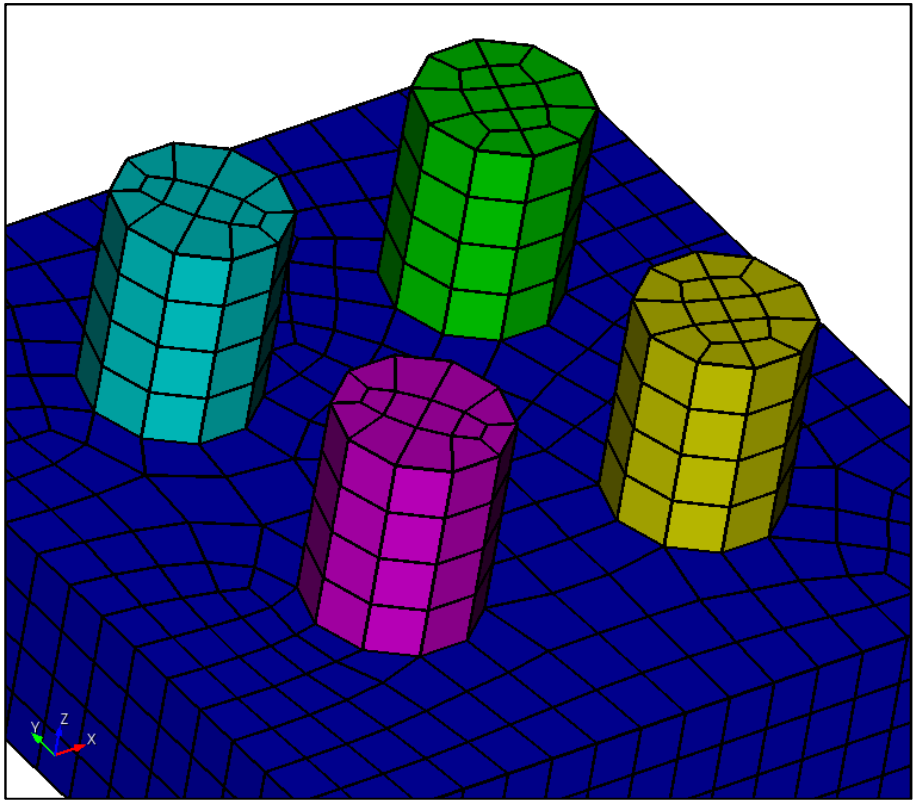


Non-Conformal

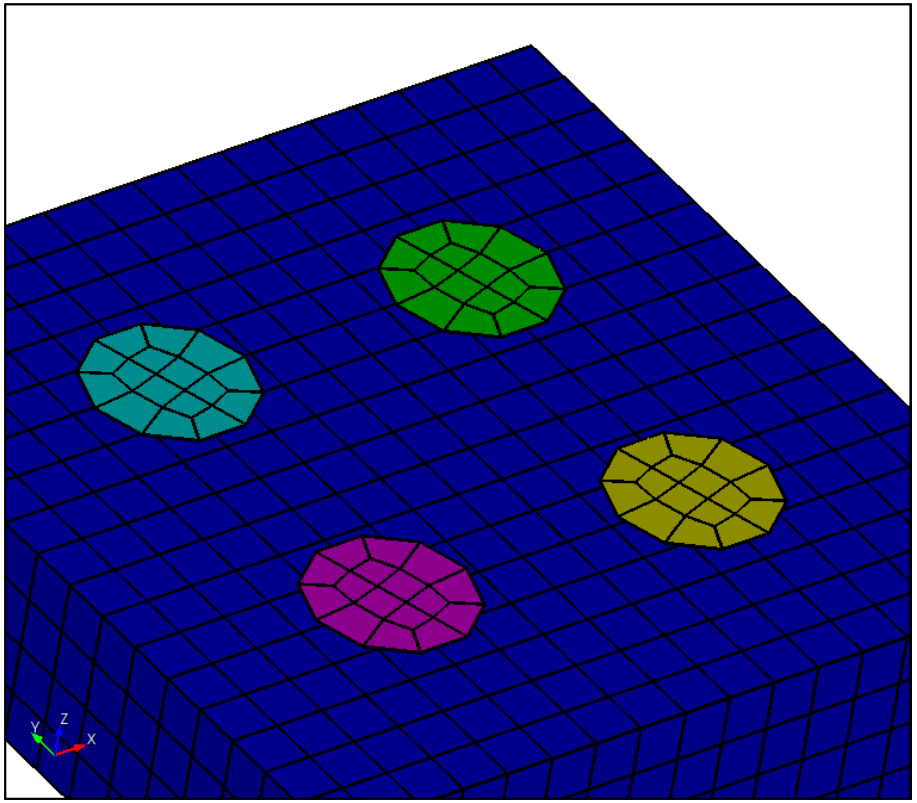


Conformal

Geometry Solution vs. Mesh Solution

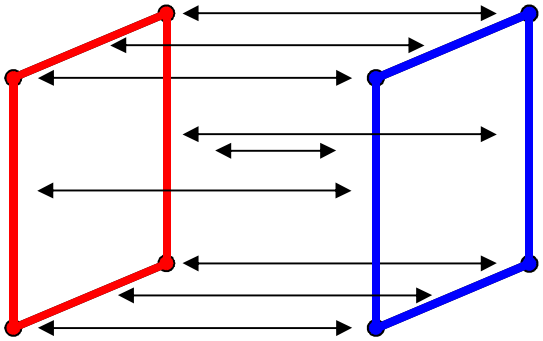


Geometry Solution (Imprint/Merge)



Mesh Solution

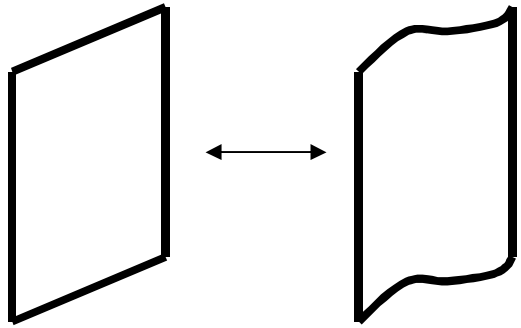
Merging Criteria



Vertices must match

Edges must match

Topological Match (Essential)



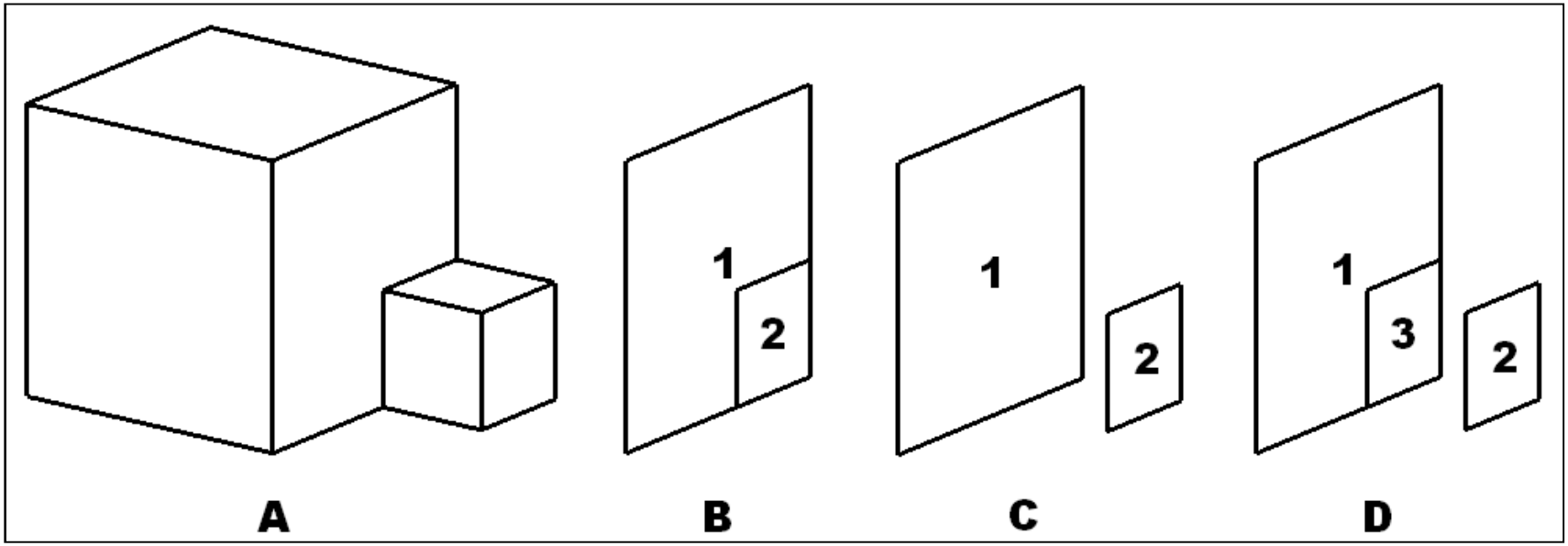
Automatically merge if within merge tolerance

Force merge if out of merge tolerance

Different geometry affects evaluation!

Geometric Match (Optional)

Imprinting—Creating the Topological Match

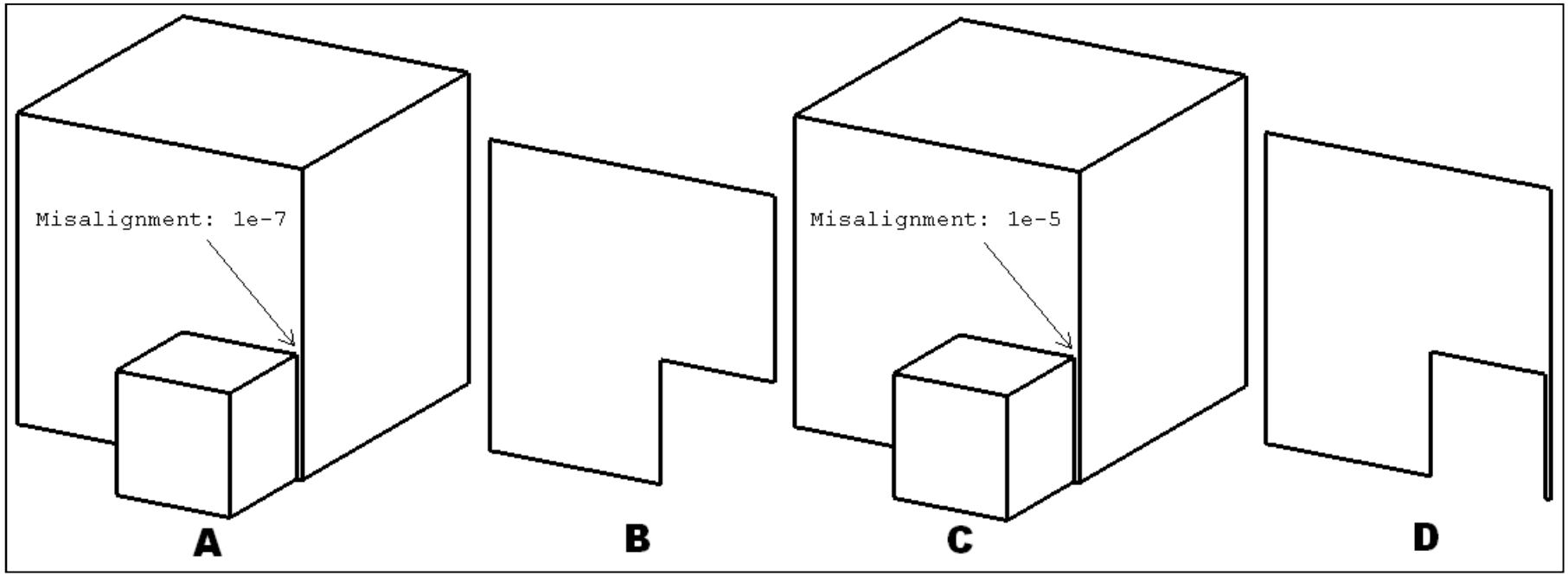


Imprinting adjacent volumes creates the matching topology required for merging.

Imprinting Tolerance

- **Imprinting is a solid modeling kernel operation**
- **Tolerance is defined by solid modeling kernel**
- **Tolerance is generally not user-modifiable**
- **2 Properties of imprinting**
  - Only entities within tolerance will imprint
  - No slivers smaller than tolerance will be introduced
- **Part adjacencies within an assembly must be cleanly defined within the imprinting tolerance or**
  - Imprint won't occur
  - Slivers will be introduced

Sliver Example

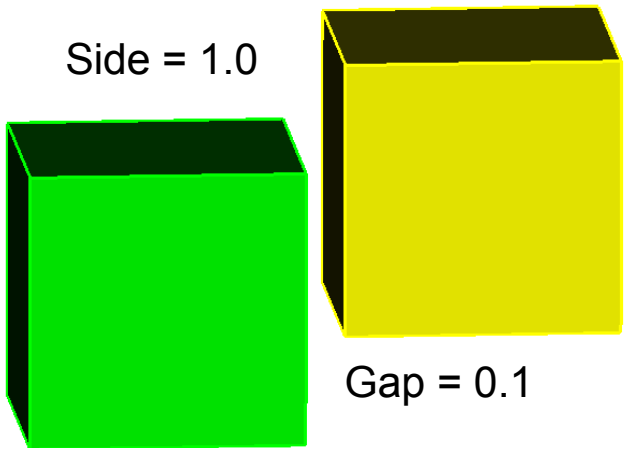


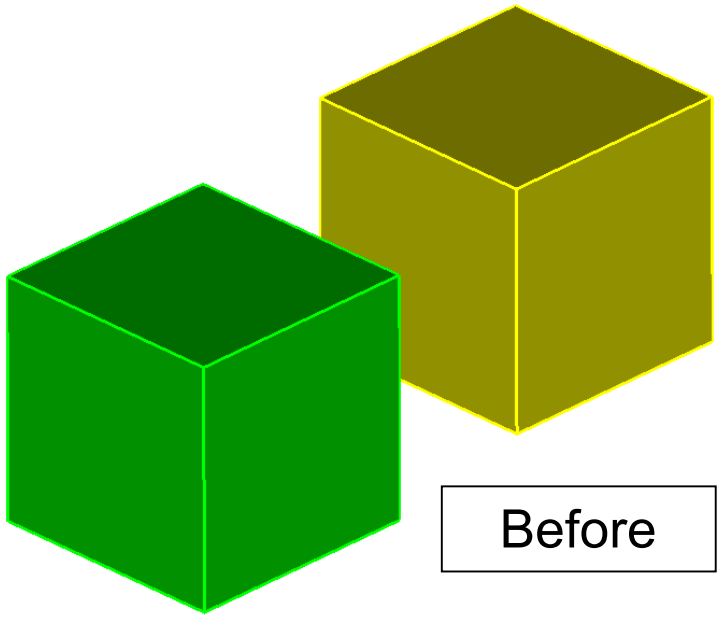
- Imprinting tolerance is 1e-6 (solid modeling kernel value)
- Results differ based on alignment of parts in assembly
- CAD systems differ in assembly constraint tolerances!

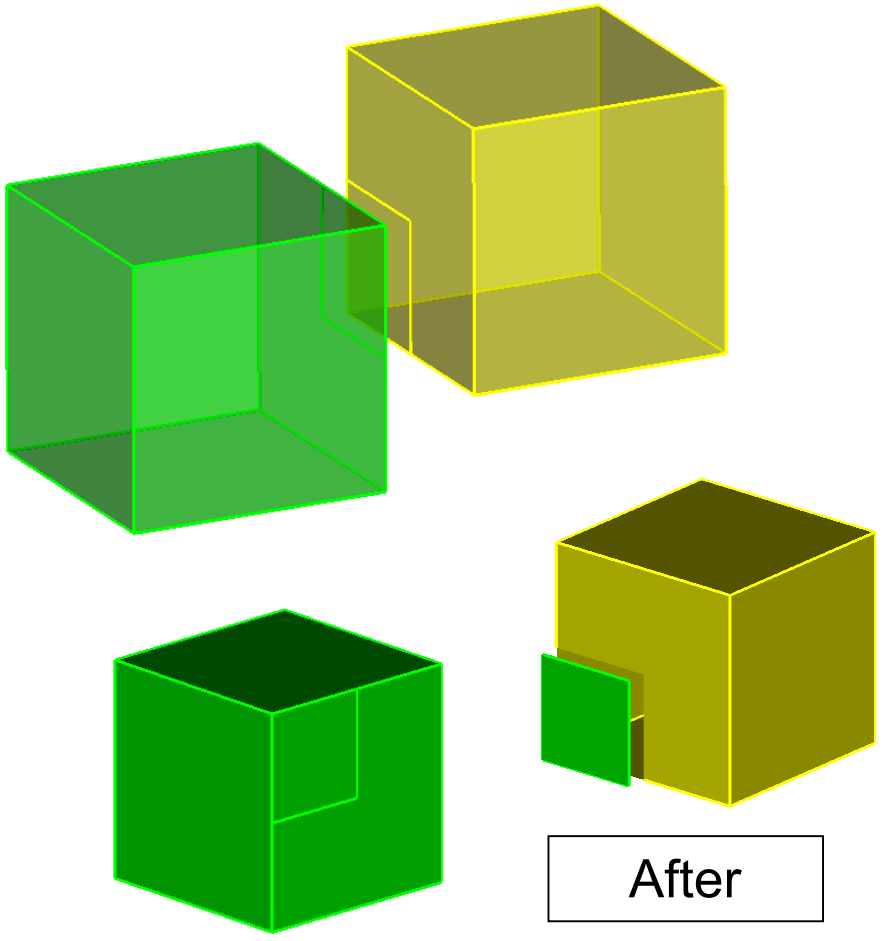
Tolerant Imprinting

- **Same as imprinting from user's point of view**
- **2 Properties still hold**
  - Only entities within tolerance will imprint
  - No slivers smaller than tolerance will be introduced
- **User can modify the imprinting tolerance**
- **Modifiable Imprinting tolerance = Merge tolerance**

Gap Example



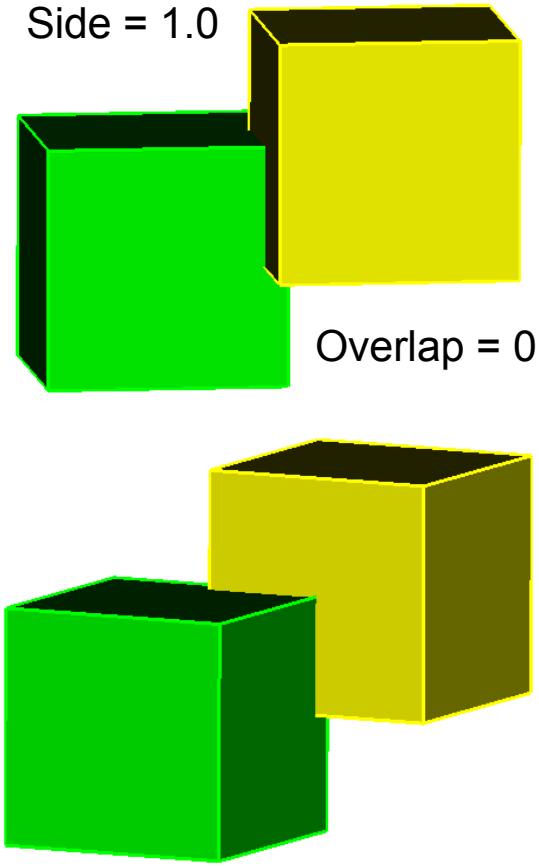




Overlap Example

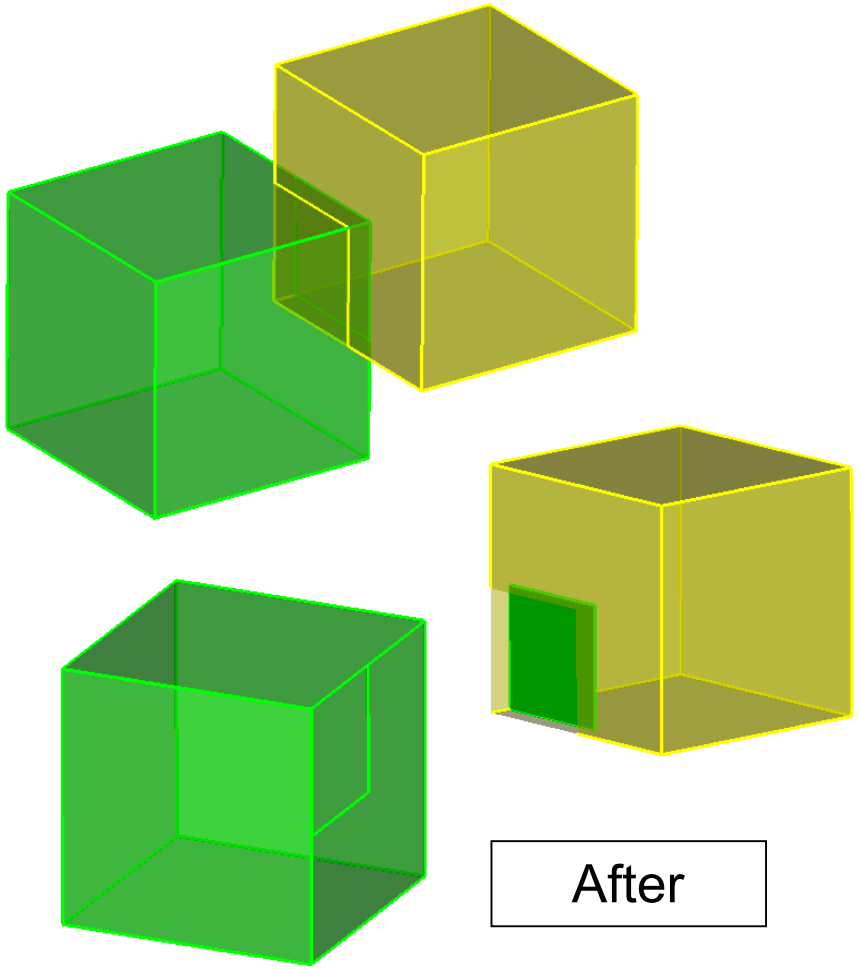
Side = 1.0

Overlap = 0.1



Before

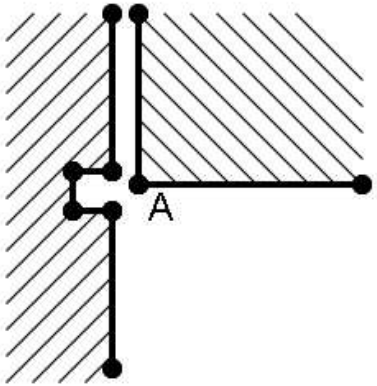
Merge Tolerance = 0.11



After

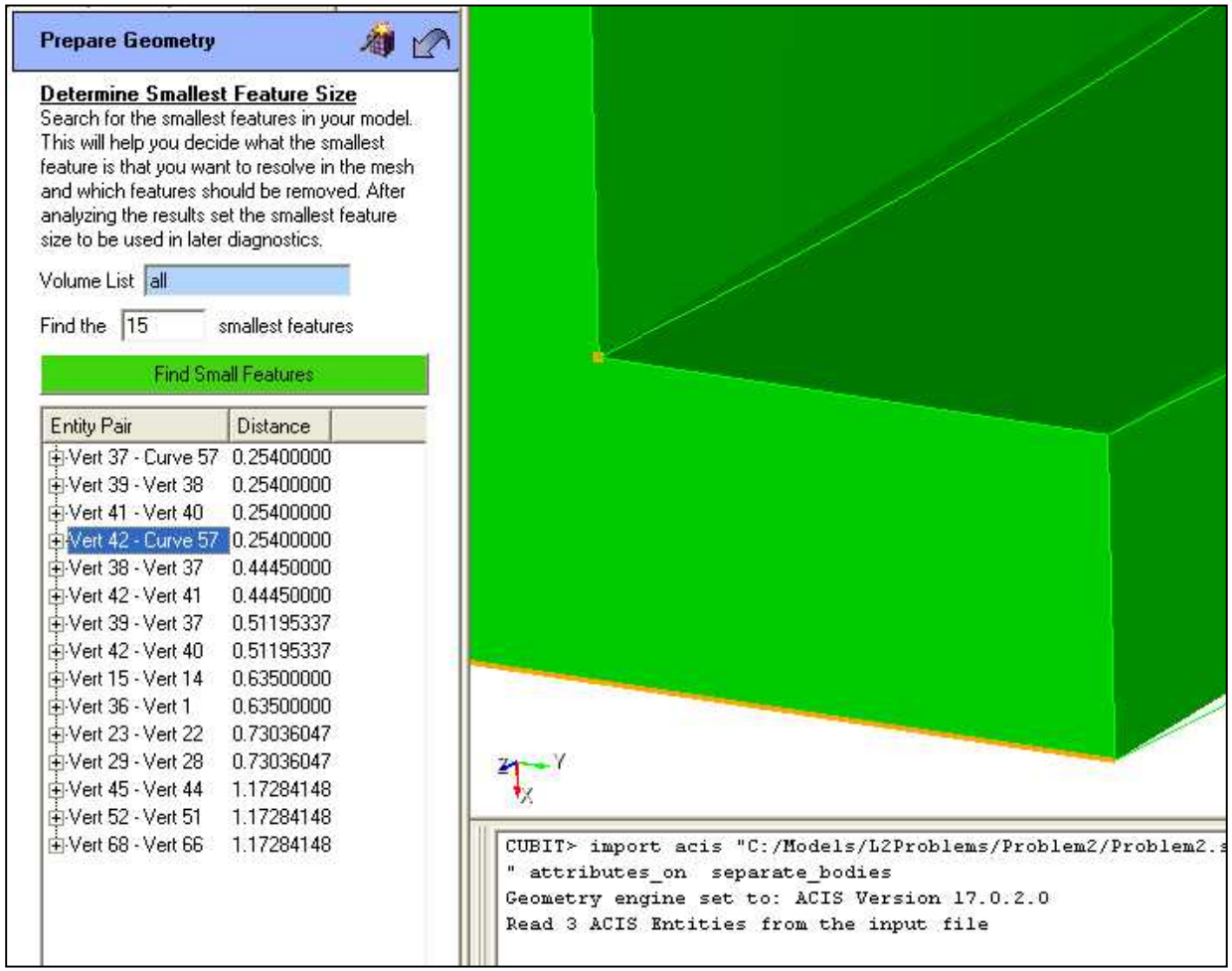
Determining Merge Tolerance

- **Must be smaller than the smallest feature**



- **Must be larger than the largest gap, misalignment, or overlap**

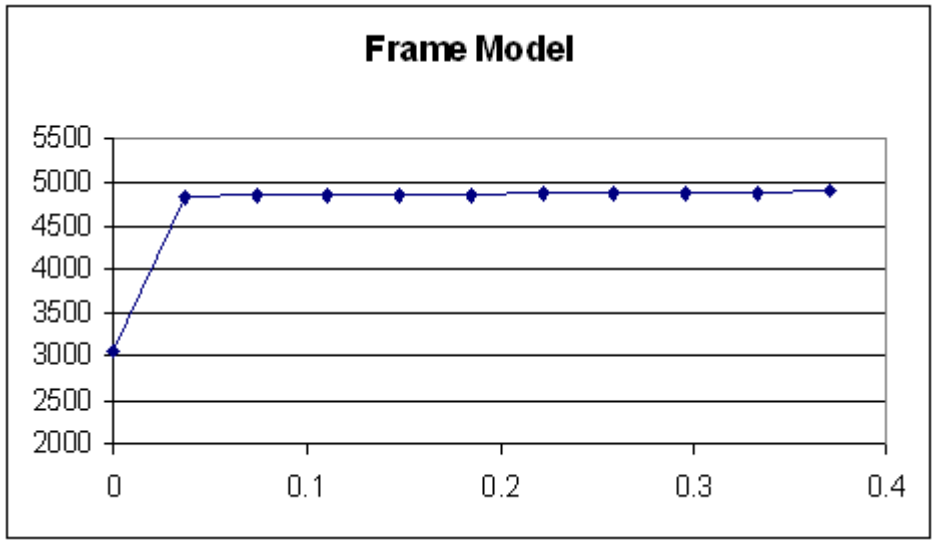
Smallest Feature



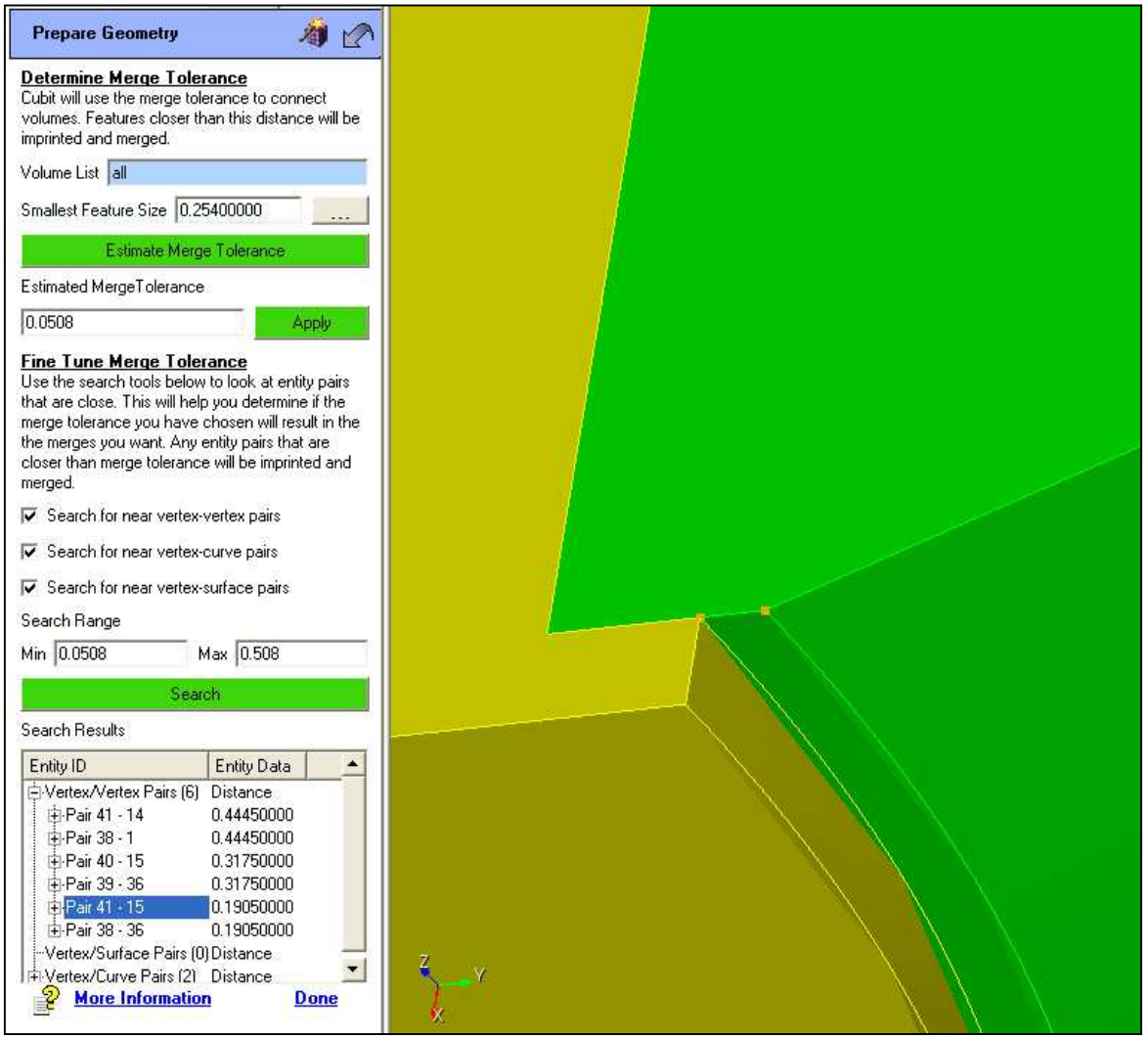
Merge Tolerance Estimator

- **Examine range from 0 to smallest feature size**
- **At different values in the range find the # of proximities**
- **Plot current value vs. # of proximities**
- **Pick off point where the plot starts to level off**

Model with ~900 volumes



Volume-Volume Proximities



Impact on Real Model

- AF&F (arming, fusing, and firing) model
- ~240 volumes
- Dense model with many volume-volume interfaces
- "Sloppy" volume-volume interfaces

	Time (min)	# Overlapping Surface Pairs
Regular Imprinting	3.5	169
Tolerant Imprinting	56	2

Conclusions

- **Tolerant imprinting will significantly reduce geometry modification time on sloppy assemblies**
- **Determining merge tolerance must be done carefully**
- **Need to continue to try to automate conformal meshing of sloppy assemblies**