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Mesh Scaling

Generation of Incrementally Finer Meshes for Solution Verification

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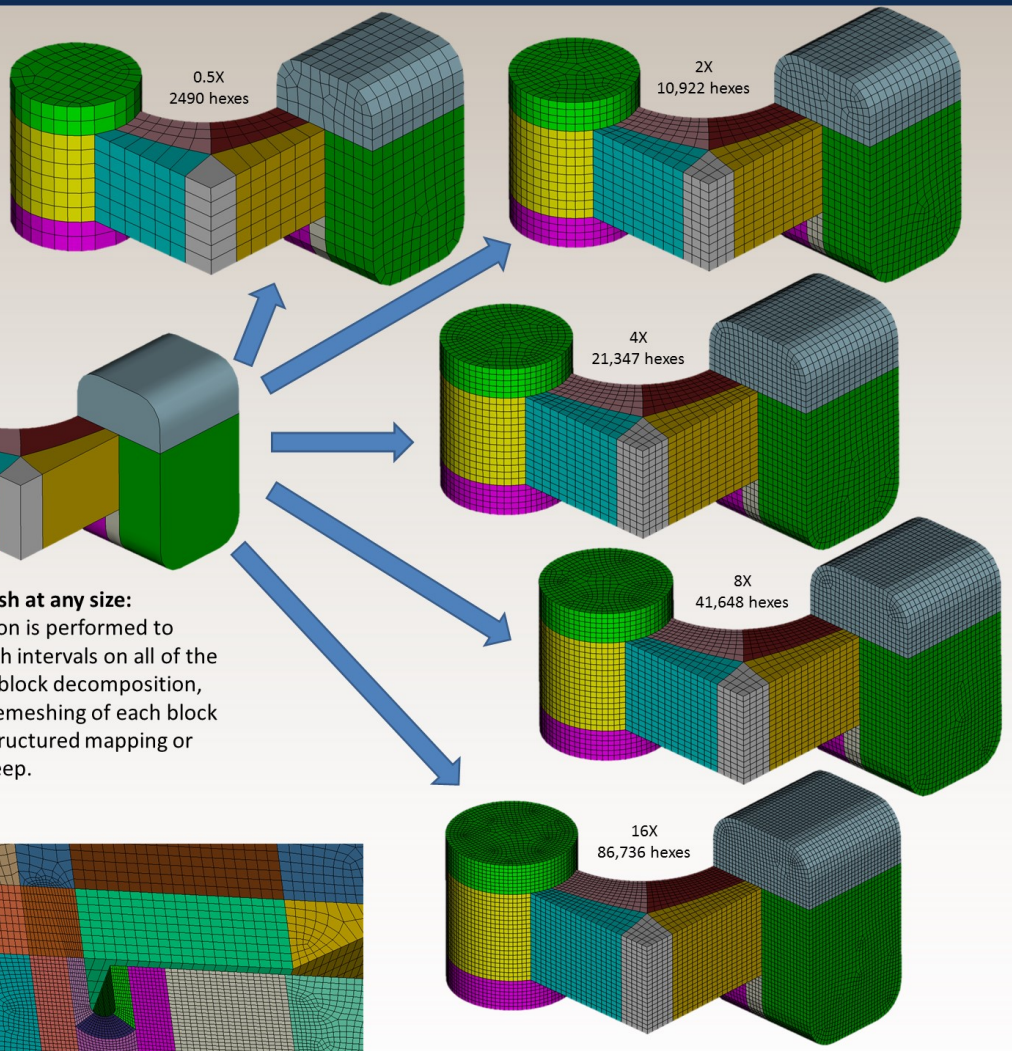
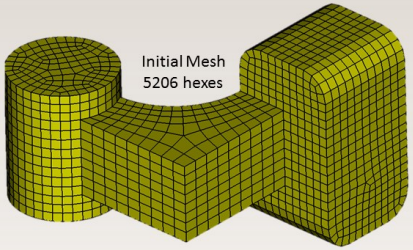
What is Mesh Scaling?

Mesh Scaling is a new mesh modification algorithm which, given an input all-hex mesh and a desired element count multiplier, N, will generate a new hex mesh with approximately N times more/less hex elements, while honoring element size grading and element orientations. Mesh Scaling offers an alternative to traditional uniform mesh refinement (UMR), without the 8X multiplier limitation.

We also introduce the next generation, "Hybrid" Mesh Scaling, which eliminates the paver from the remesh process, enabling algorithmic scaling to HPC platforms.



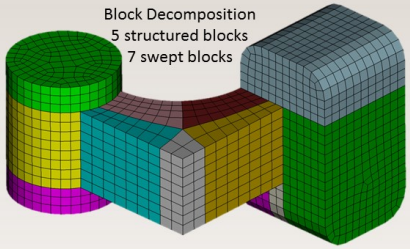
How Does Mesh Scaling Work?



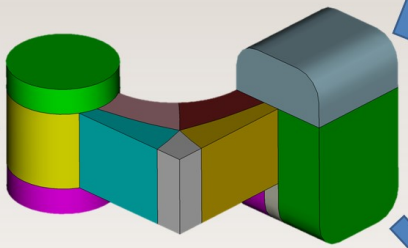
Step 1: Extract the Block Decomposition:
Hex mesh topology is traversed looking for:

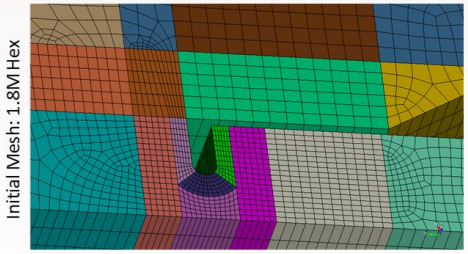
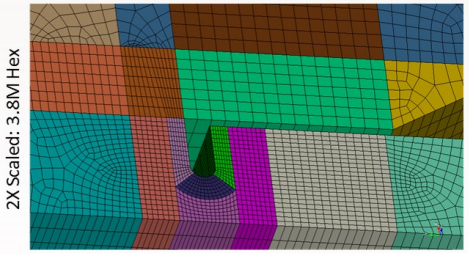
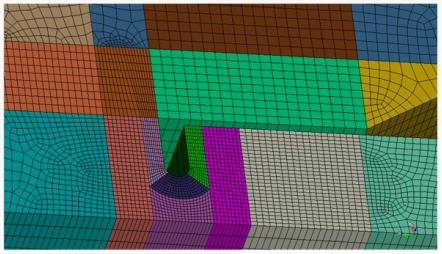
1. Swept mesh connectivity, AND
2. Structured zones separated by mesh singularities

The mesh is then decomposed into both structured and swept blocks



Step 2: Delete Initial Mesh:
Mesh sizing, grading, orientation, and BC loading are extracted from the mesh and stored in the block decomposition. The original mesh is then deleted.



Step 3: Remesh at any size:
An optimization is performed to compute mesh intervals on all of the curves in the block decomposition, followed by remeshing of each block with either structured mapping or Pave-and-sweep.

Solid Mechanics (SM) Model