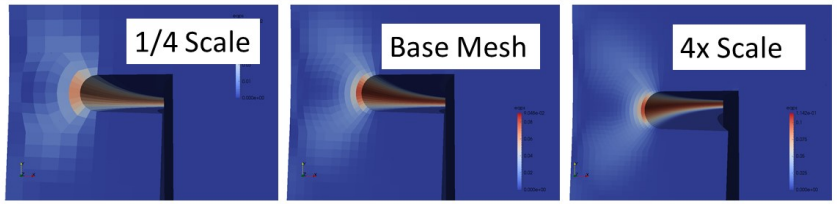
Solution Verification and Mesh Scaling



The model simulates weld failure from thermal/mechanical loading. The main output is the maximum equivalent plastic strain (EQPS), an indicator of weld failure.

Solution verification (quantified numerical error estimation)

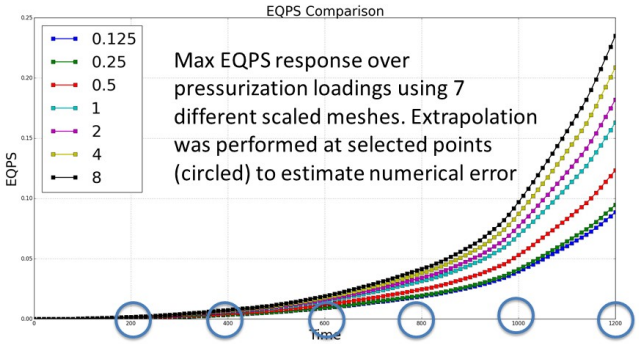
- is required for simulation prediction uncertainty
- typically requires a >100x increase in cost for a 3 grid sequence (using 8x, 64x scale factors)

The Mesh Scaling alternative:

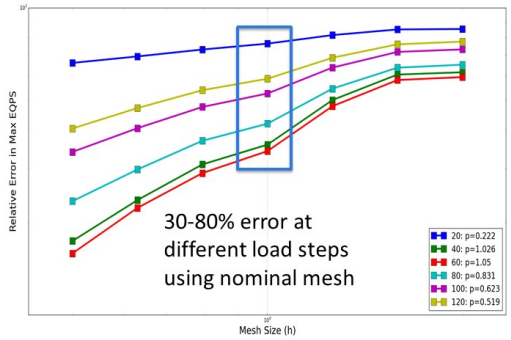
- provides fine grained capability to generate a sequence of meshes – including coarsening
- Is used in solution verification with significant cost savings

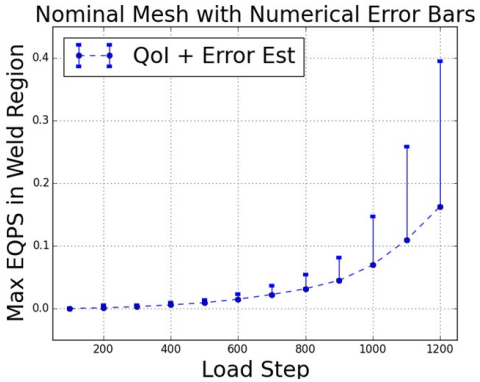
Impact of Mesh Scaling:

- has enabled solution verification of all-hex models - solid mechanics and structural dynamics
- future work will increase impact to all mesh-based simulation models (tet meshes)



Error estimates as a function of mesh size from extrapolation using mesh scaling (at selected points on the load history).





Future Research:

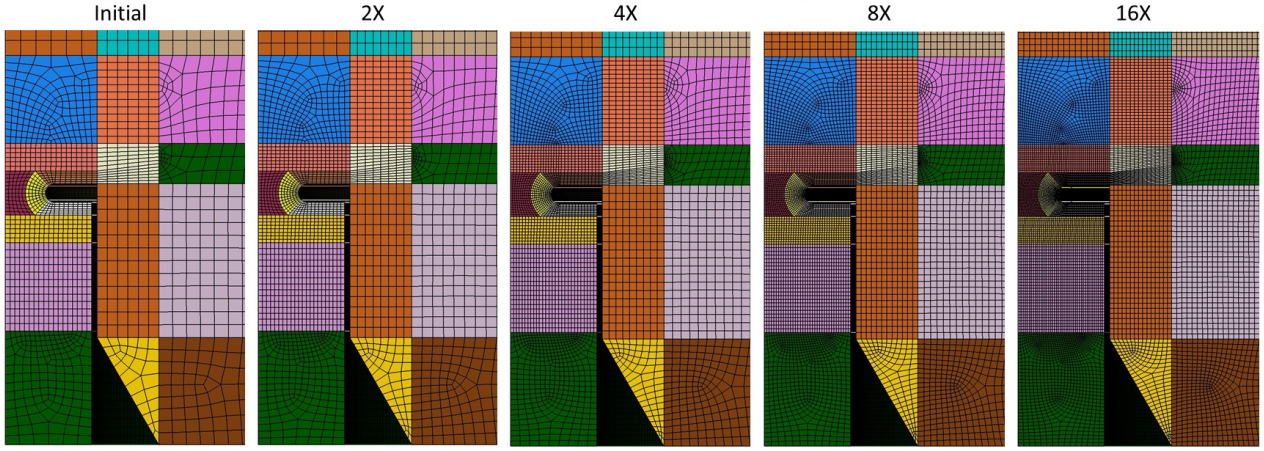
Calling the Paver to remesh swept blocks is the weak link in the current mesh scaling algorithm. Paving:

- Results in unpredictable structure and quad count
- Inherently serial, can not scale to HPC
- No guarantee of certain number of layers through thin sections

We have prototyped a new "Hybrid" method to mesh scaling:

- Modifies original mesh with strategic dicing and smoothing
- No Paver
- Maintains number and type of singularities → structure
- Parallelizable
- Can guarantee certain number of layers through thin sections

Example Model Scaled With Hybrid Mesh Scaling



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