SAND2011-3911P

Computational Modeling Sciences Department

Comparison of Mesh Warping Methods for Shape Optimization

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Background

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We start with an initial geometry with an initial mesh. Parametric variables are modified and the CAD model is regenerated. Currently, we assume the topology of the CAD model remains unchanged. We morph (warp) the mesh to the new geometry, keeping mesh topology constant. In this study, we compare 6 different morphing methods.

1. **Smoothing** – Displace boundary nodes, then call smoother to adjust interior nodes
2. **Weighted Residual** – Compute a transformation based on boundary node movement and associated boundary node error. Apply transformation to interior nodes and correct.
3. **Simplex Linear** – Create bounding tet mesh, compute barycentric coords of each interior node, and apply using displaced boundary nodes
4. **Simplex Natural Neighbor** – Same as simplex linear, except use natural neighbor coordinates
5. **LBWarp** – log barrier, compute weights for each interior node's neighbors, then assembly sparse system with displaced boudary as constraints.
6. **FEMWarp** – FEA based, apply linear finite elements using displaced boudary as constraints.

Bore Model

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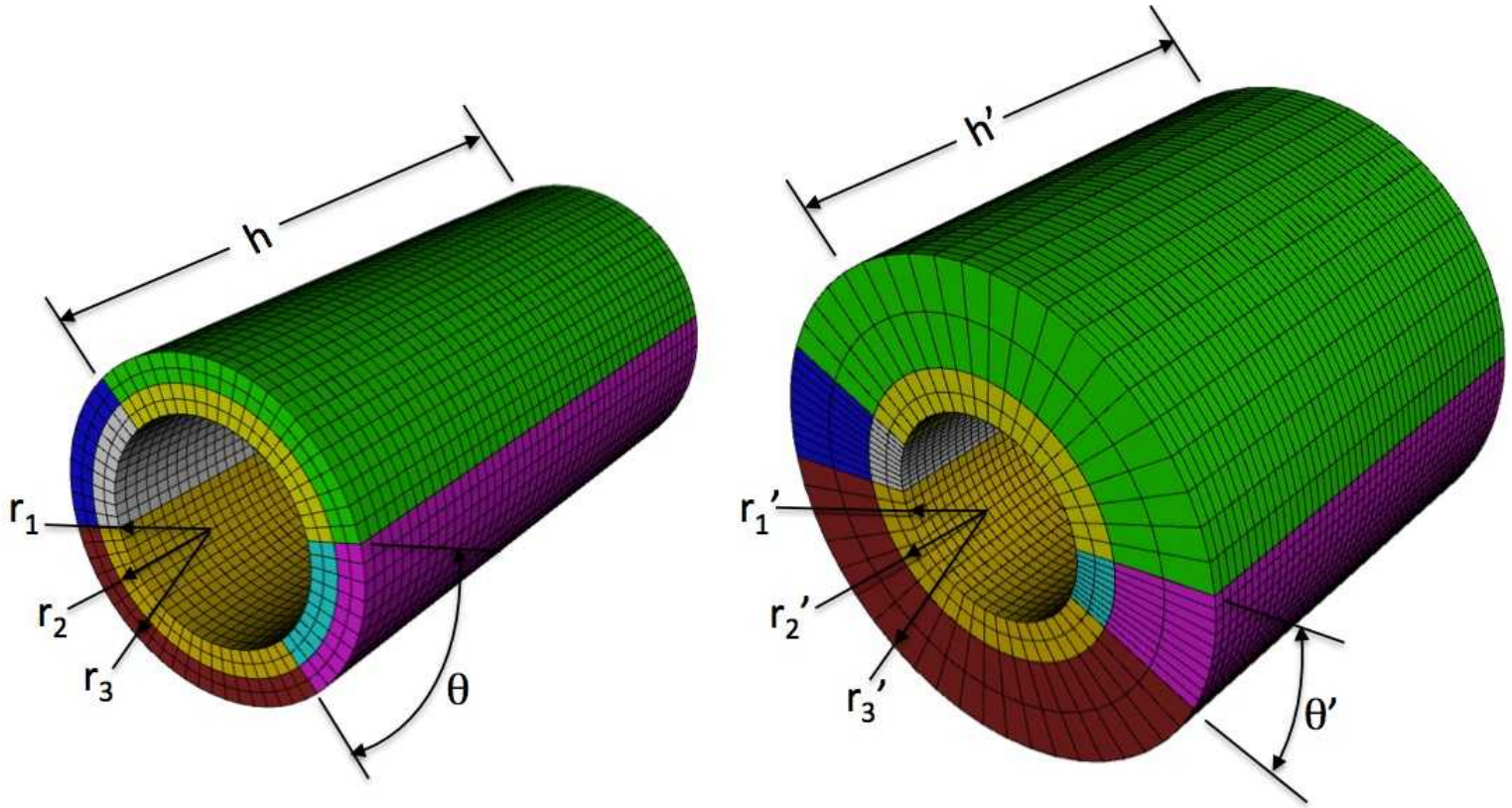

Bore Model – Element Quality
Comparison of Warping Methods

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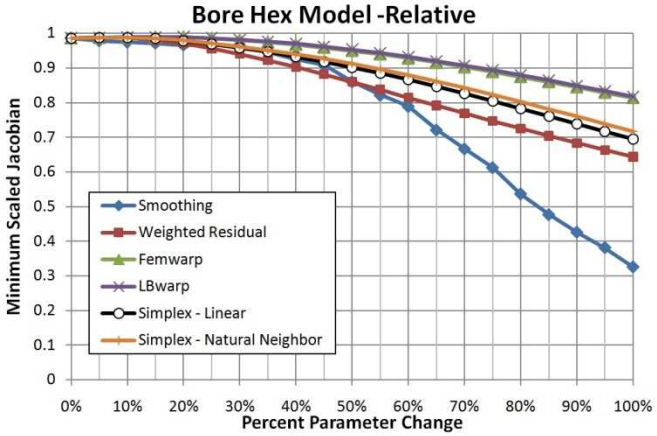

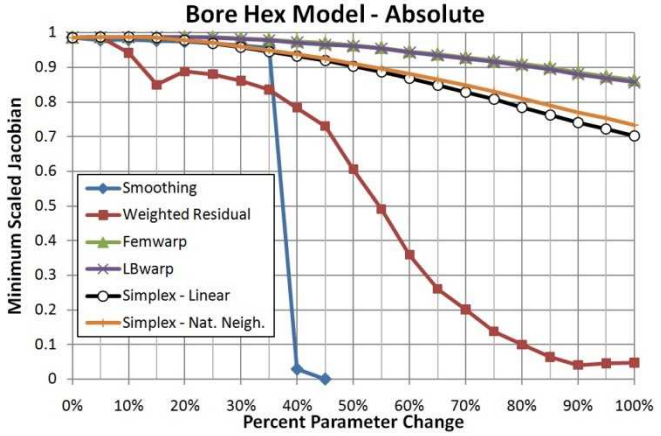

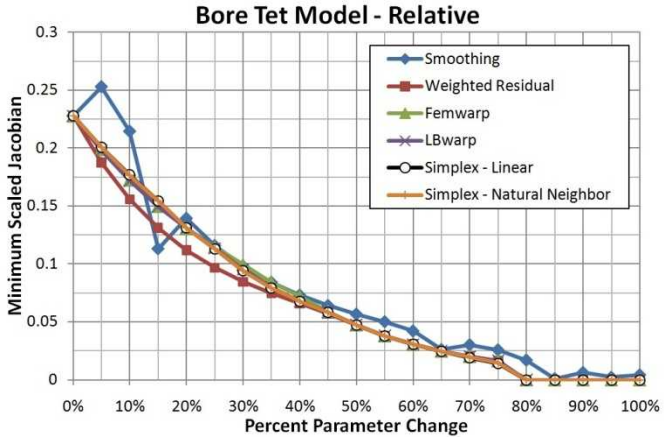

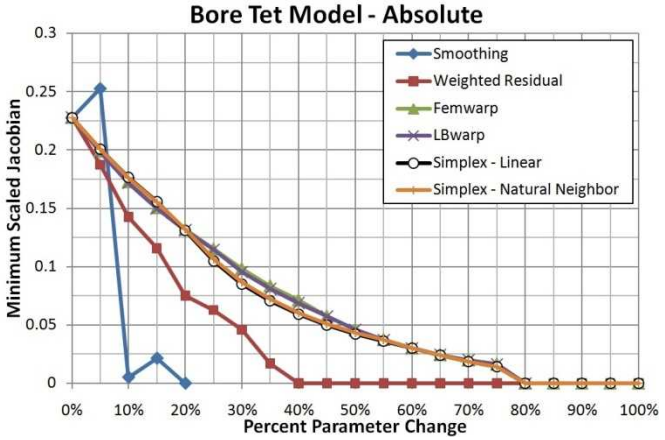

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Courier Model

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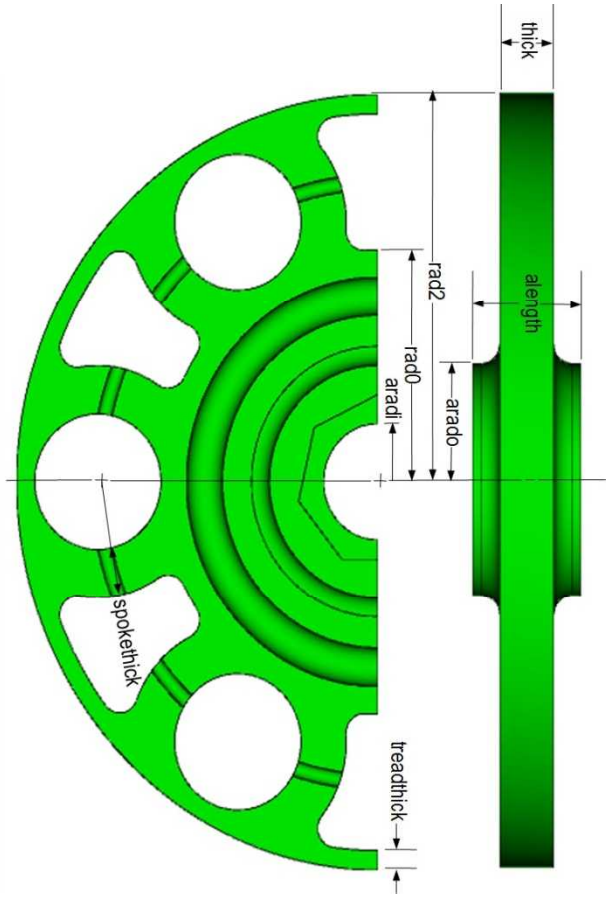

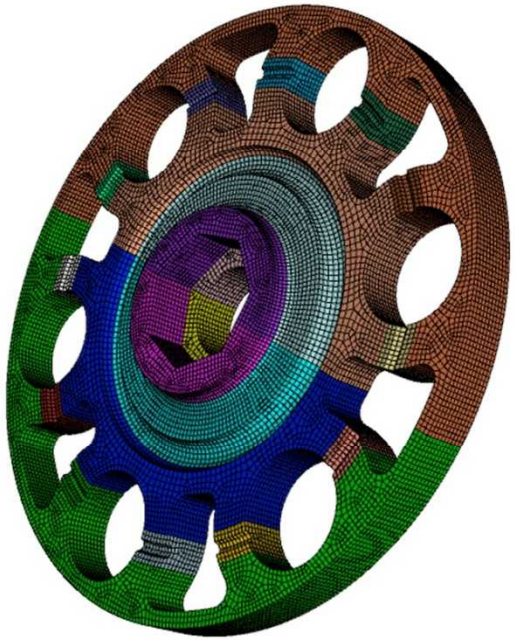

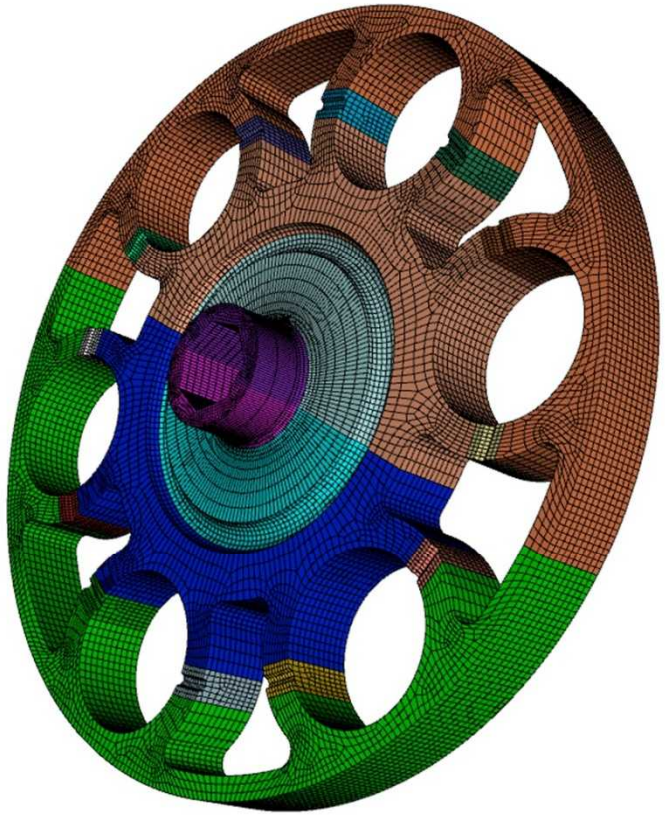

Courier Model – Element Quality
Comparison of Warping Methods

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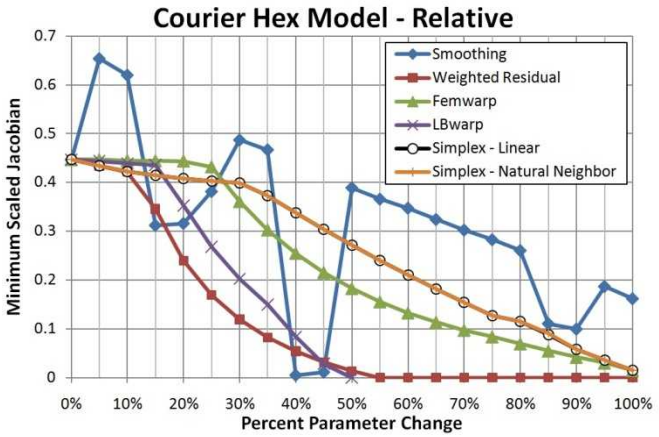

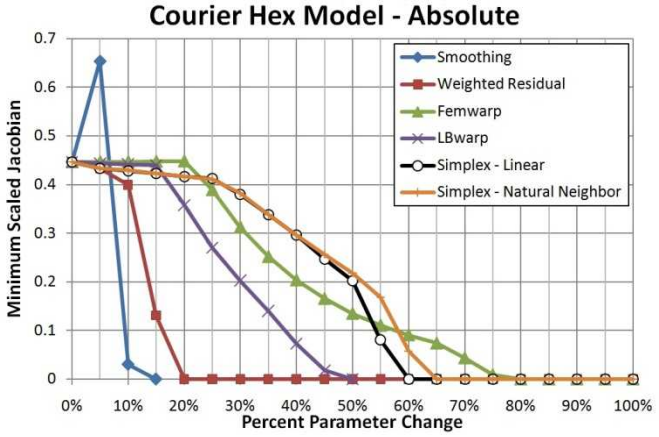

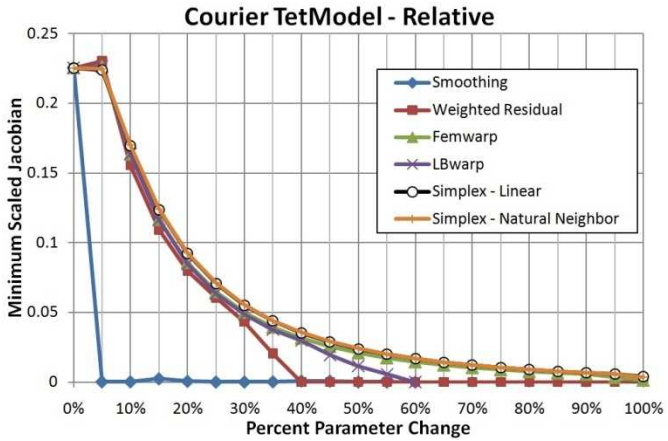

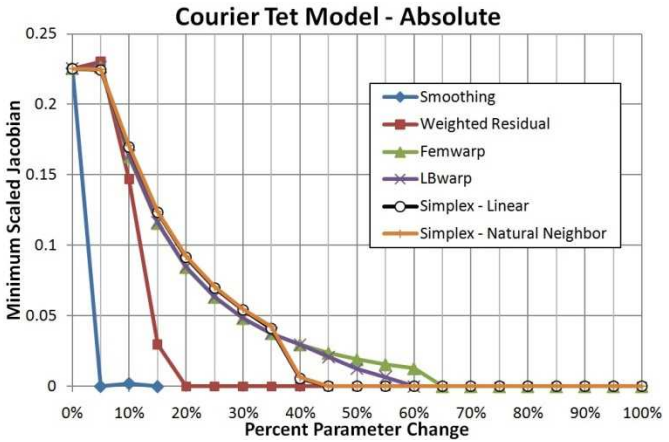

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Scaling (Ave Time Per Step)

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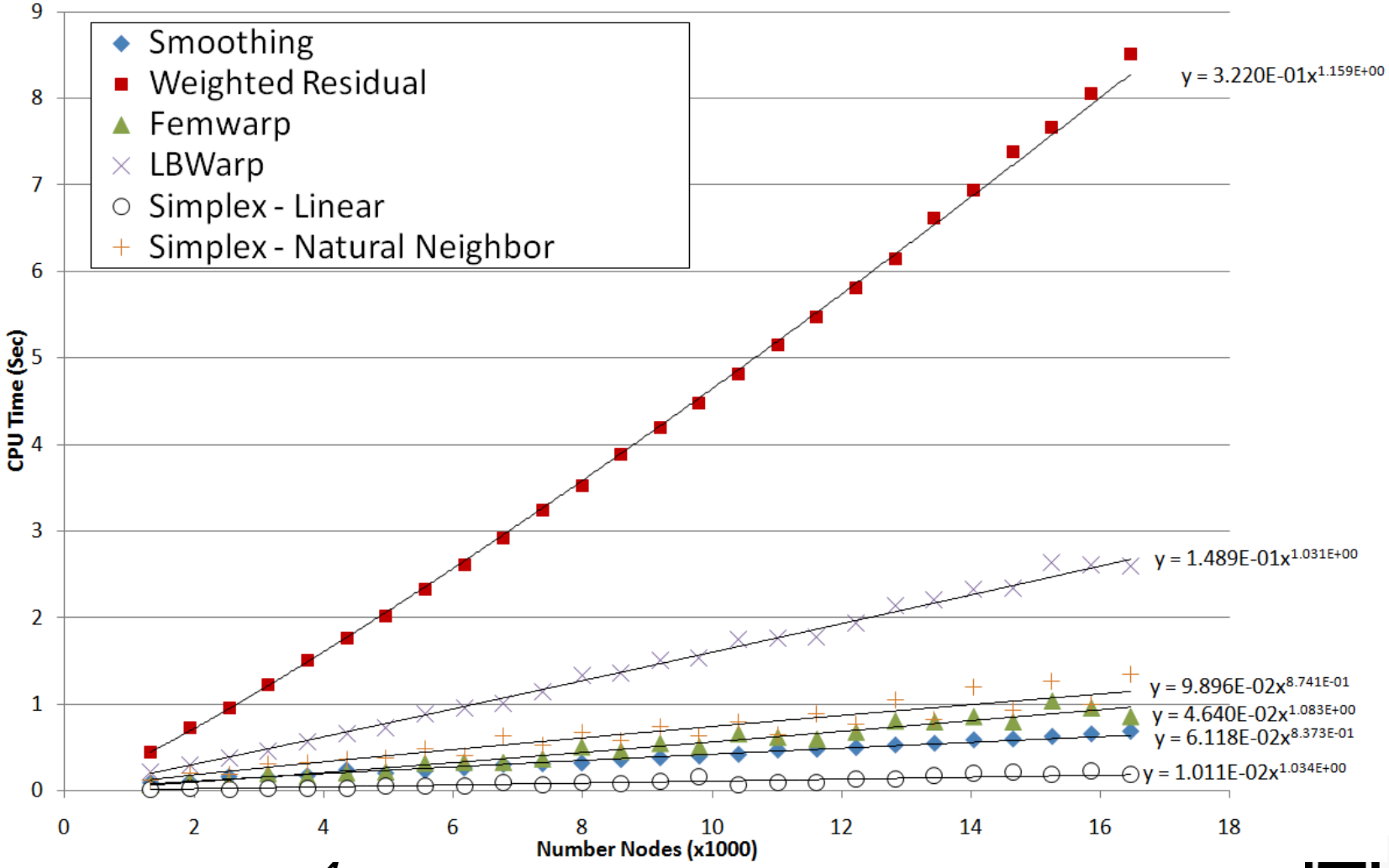

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