In Search of “Grail, Gold Standard” Mesh Metrics

- Mesh metrics generally have a mathematical basis that is strongly founded upon computational principles and geometric issues [Knupp, 2000; Knupp, 2003].
- By the start of the 21st century, the general notion was, and continues to be, that mesh metrics need to show that elements are not unduly deformed geometrically [Fluent, 2009; Fluent, 2012].
- Therefore, excellent, general mesh guidelines should include the following considerations:
  - ✓ Stretching (length issues)
  - ✓ Distortion (angle issues)
  - ✓ Transitioning (distance and propagation issues between adjacent elements)
  - ✓ Adequate computational variable mapping onto node distribution

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- Consequently, a complete set of mesh metrics ought to consider at least the following relevant and independent criteria:
  - ✓ length ratios,
  - ✓ element angles,
  - ✓ distance between adjacent nodes (i.e., a growth ratio; y^+),
  - ✓ an approach that gauges the computational variable’s mapping onto the node distribution.

My “Grail, Gold Standard” Mesh Metrics Set

- ✓ Aspect ratio ≤ 5 (the closer to 1.0, the better; considers length ratios)
- ✓ Skew ≤ 0.5 (the closer to 0.0, the better; factors in element angles)
- ✓ Expansion ratio ≤ 1.5 (the closer to 1.0, the better; gauges node-to-node distance growth between adjacent nodes/elements)
- ✓ Scaled Jacobian ≥ 0.5 (the closer to 1.0, the better; a measure of the computational variable mapping onto the node distribution)
- ✓ And of course, y^+ must be considered as well. (Most RANS models require the first computational node at $y^+ = 1$; Wilcox noted his 2006 k-ω can have the first computational node at $y^+ = 5$). Use node biasing to reduce the node count.