BCFD/AFLR Unstructured Grids: NASA Common Research Model for the 4th Drag Prediction Workshop

Mori Mani

Boeing Research & Technology
Platform Performance Technology

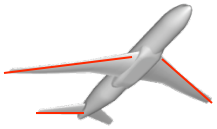
4th CFD Drag Prediction Workshop

San Antonio, Texas – June 2009

Geometry Prep

- Multiple sources supported
- Automated Repair
- Tools for defeaturing and complex repair

Feature Detection



- UIUC and Boeing algorithms
- Automatic and manual detection of wing LE, TE, tips, curvature, corners, proximity ...

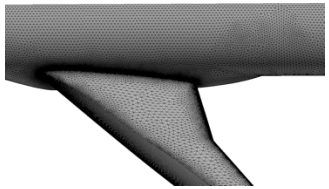
Background Mesh

- Provides framework for smooth integration of mesh properties
- Translation of properties between models

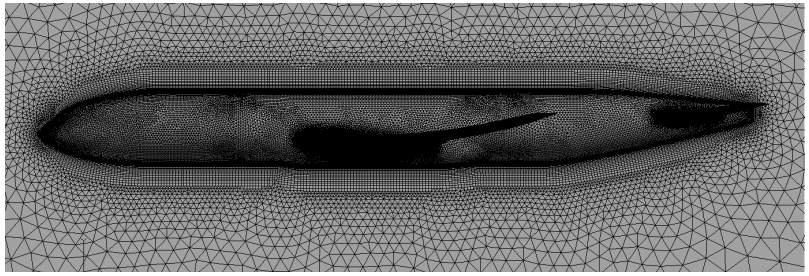
Property Assignment

- Boeing algorithm automatically adapts to geometry features
- Integrates best practices

Mesh Generation



- Automated Surface/ Volume Generation
- Quality/Resolution Control



Automated High Quality Mesh

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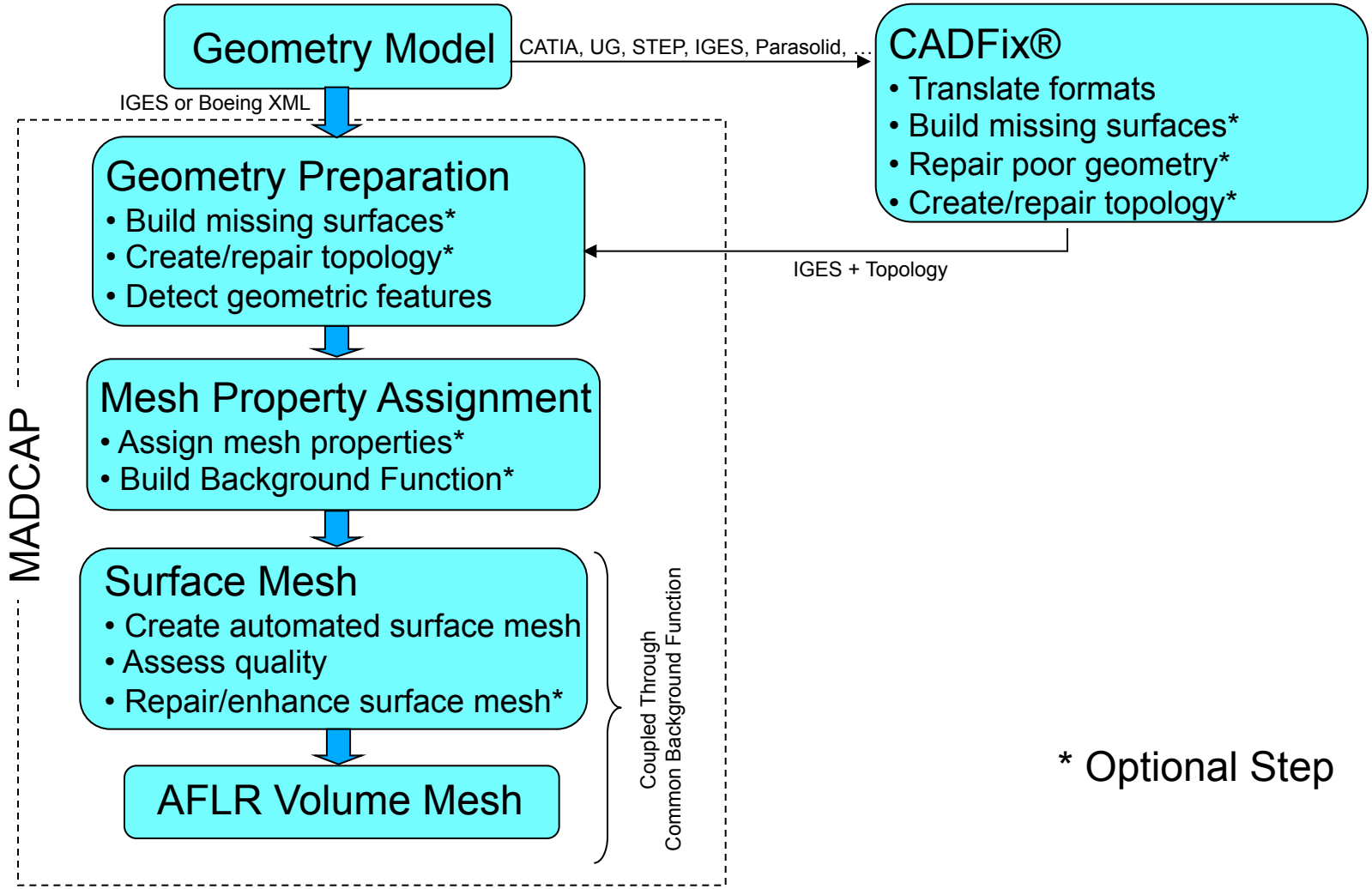

* Optional Step

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Grid	*Tail Setting*	*BL Cells (millions)*	*Total Cells (millions)*
Coarse	0	3.88	6.18
Coarse-fine	0	4.54	7.11
Medium	0	16.94	21.56
Medium-fine	0	17.57	22.30
Fine	0	33.37	55.43
X-Fine	0	72.04	109.40
Medium	ih -2	16.88	21.48
Medium	ih +2	16.98	21.61
Medium	none	10.79	13.54
Fine	ih -2	33.52	55.73
Fine	ih +2	33.60	56.00
Fine	none	19.94	32.79
Fine (Re=20M)	0	36.08	58.52

- DPW guidelines adhered to for the CRM grids
- Grids designed for a cell-centered solver
- Coarse-fine and medium-fine grids have fuselage grid densities similar to that of the fine grid

- Also created a set of “best practice” grids which are available on the NASA ftp site
- These grids used a constant first cell height of 0.0001” regardless of grid size
- AFLR parameters closer to default values
  - Max growth ratio of 1.2 in boundary layer
- Due to limited computing resources, we were not able to solve on these grids. We feel they will show less sensitivity to viscous drag with the SST model.

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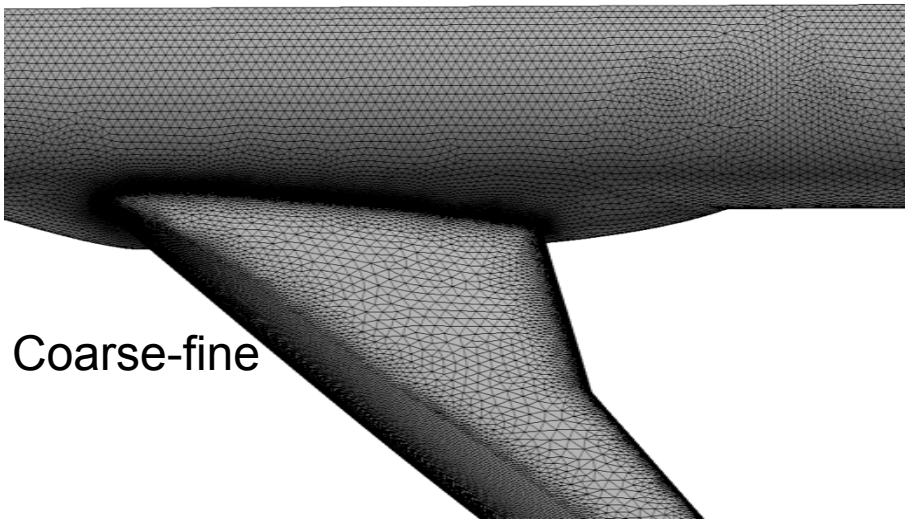

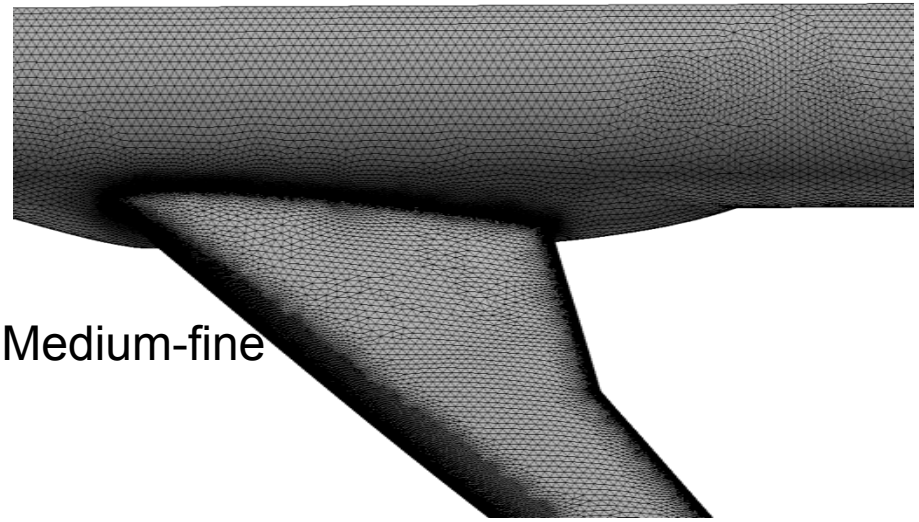

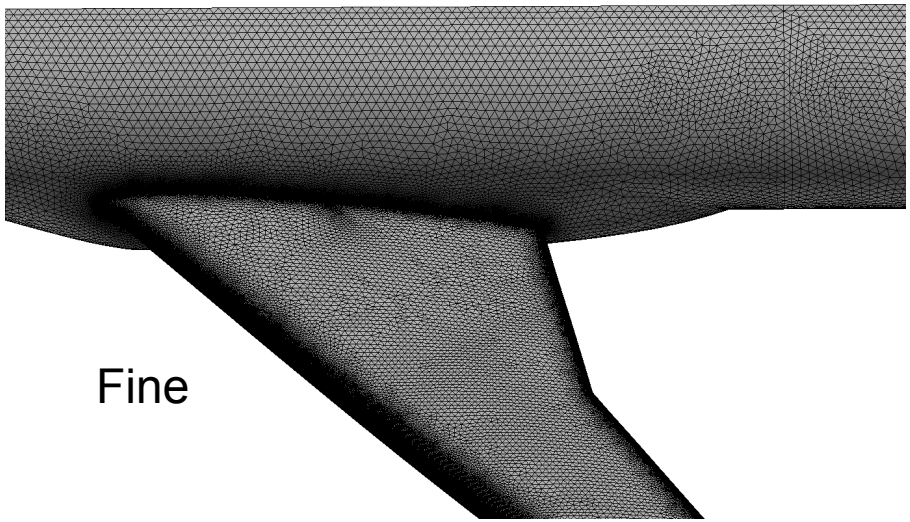

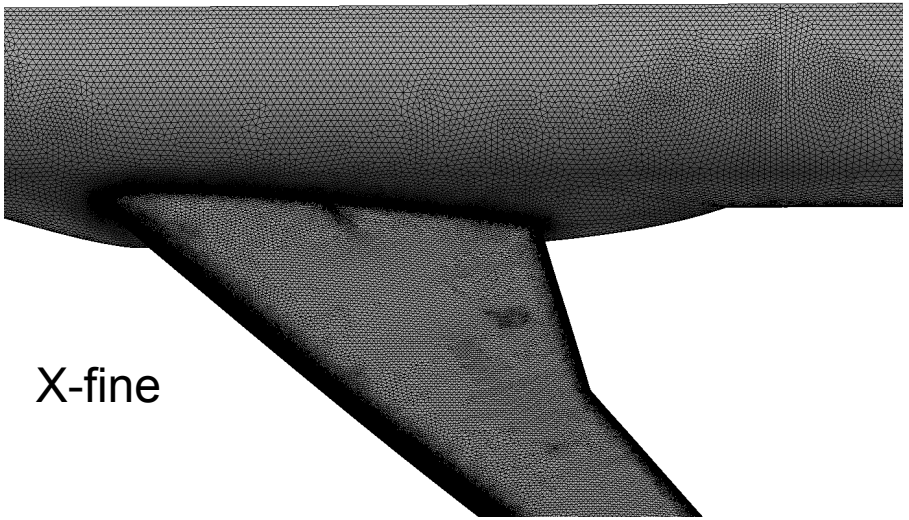

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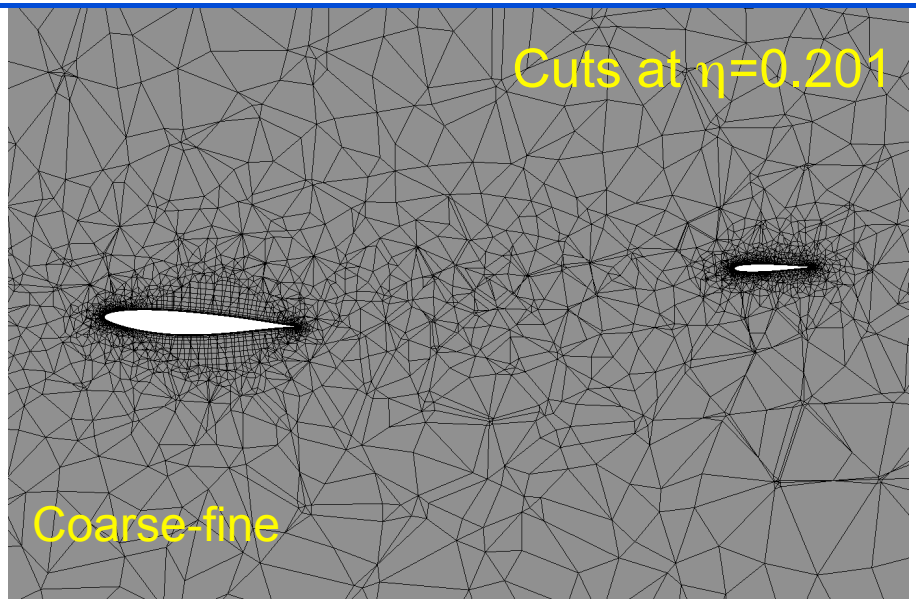

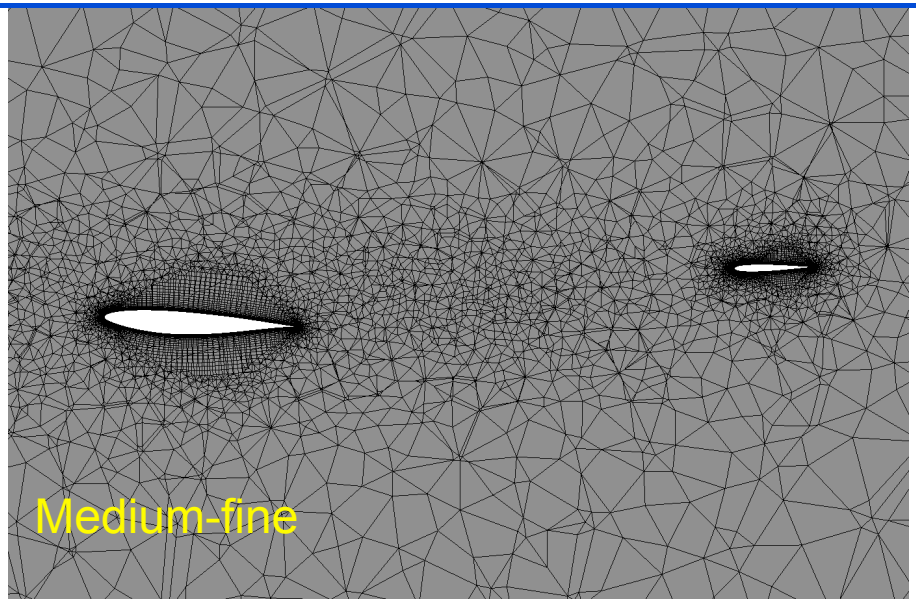

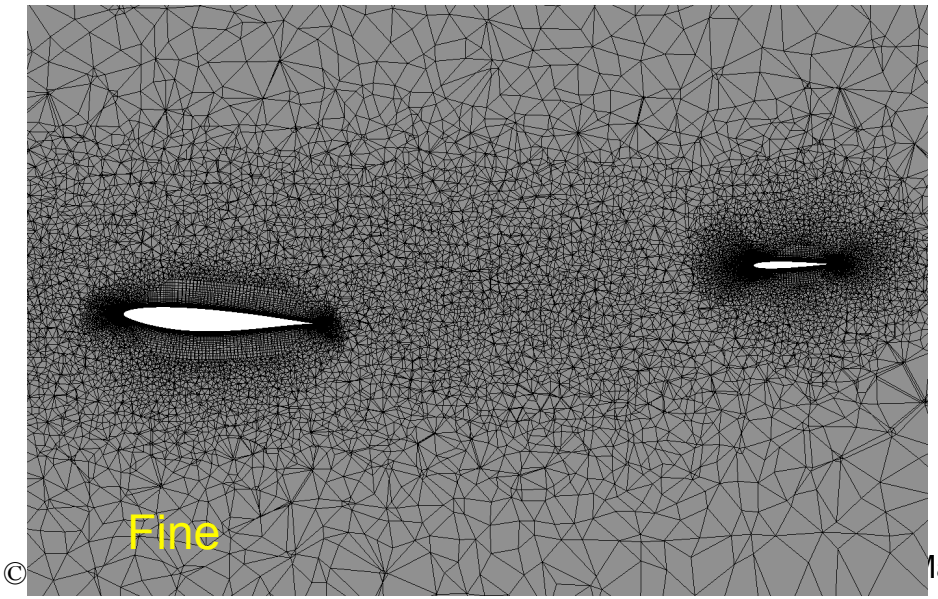

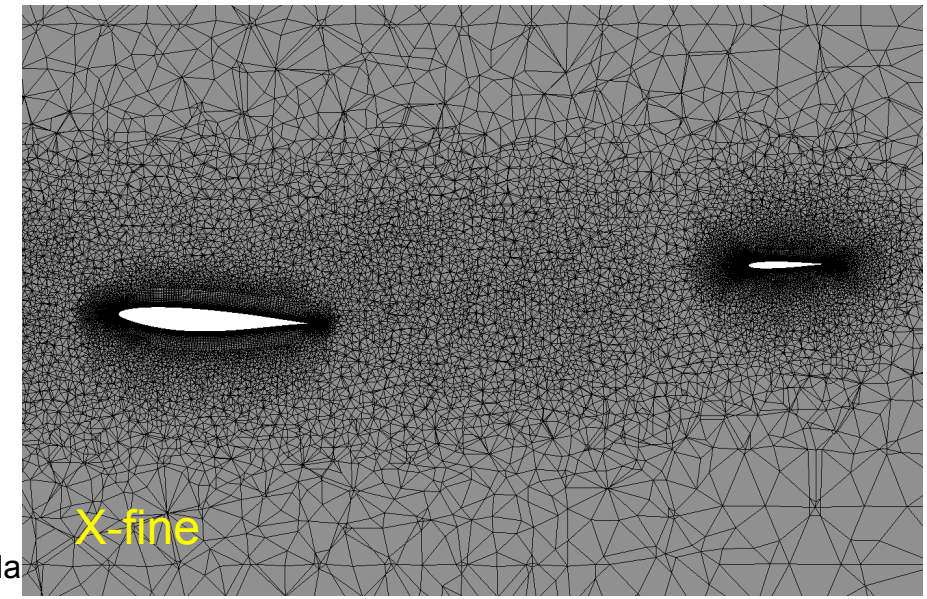

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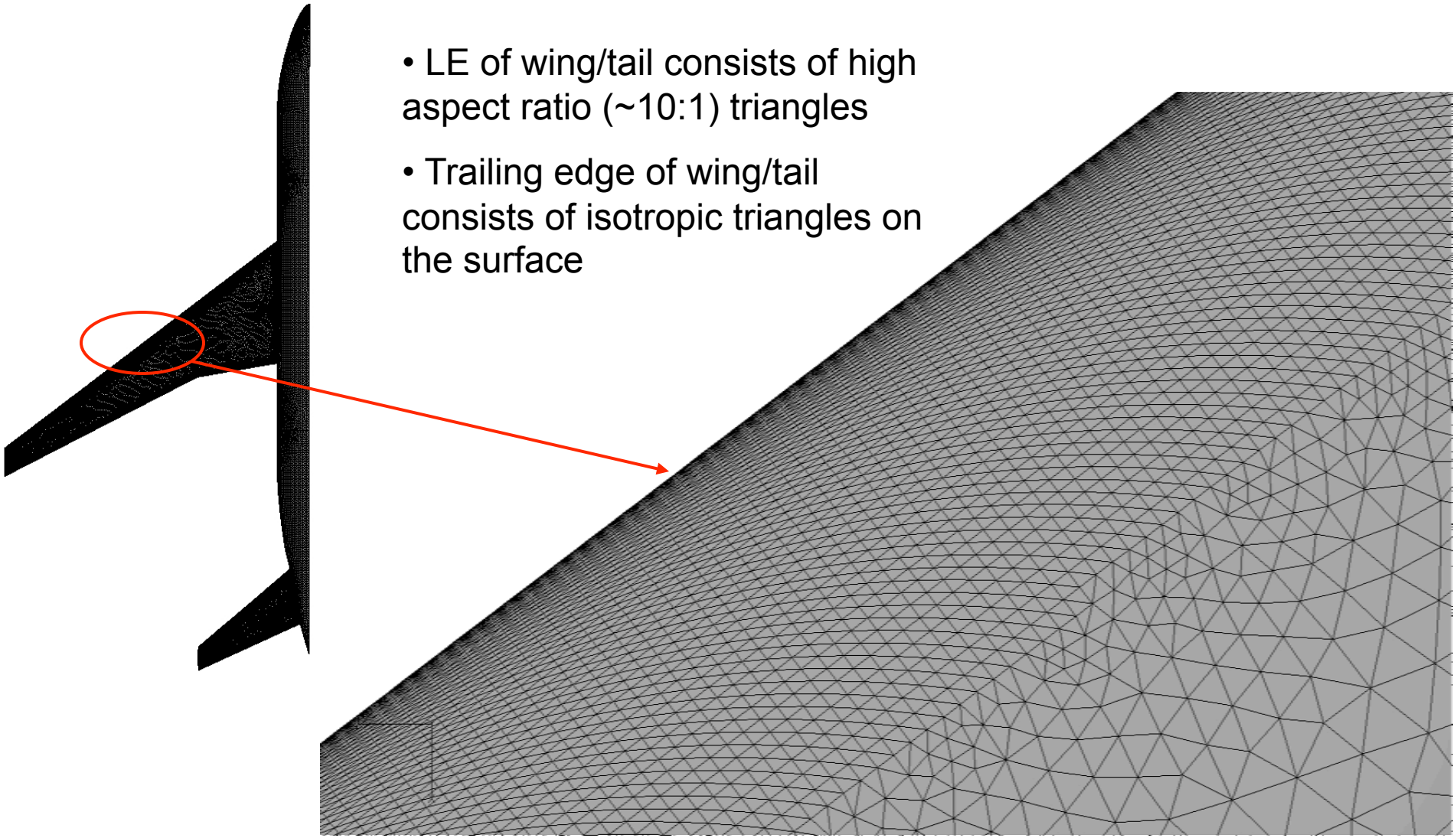
- LE of wing/tail consists of high aspect ratio (~10:1) triangles
- Trailing edge of wing/tail consists of isotropic triangles on the surface



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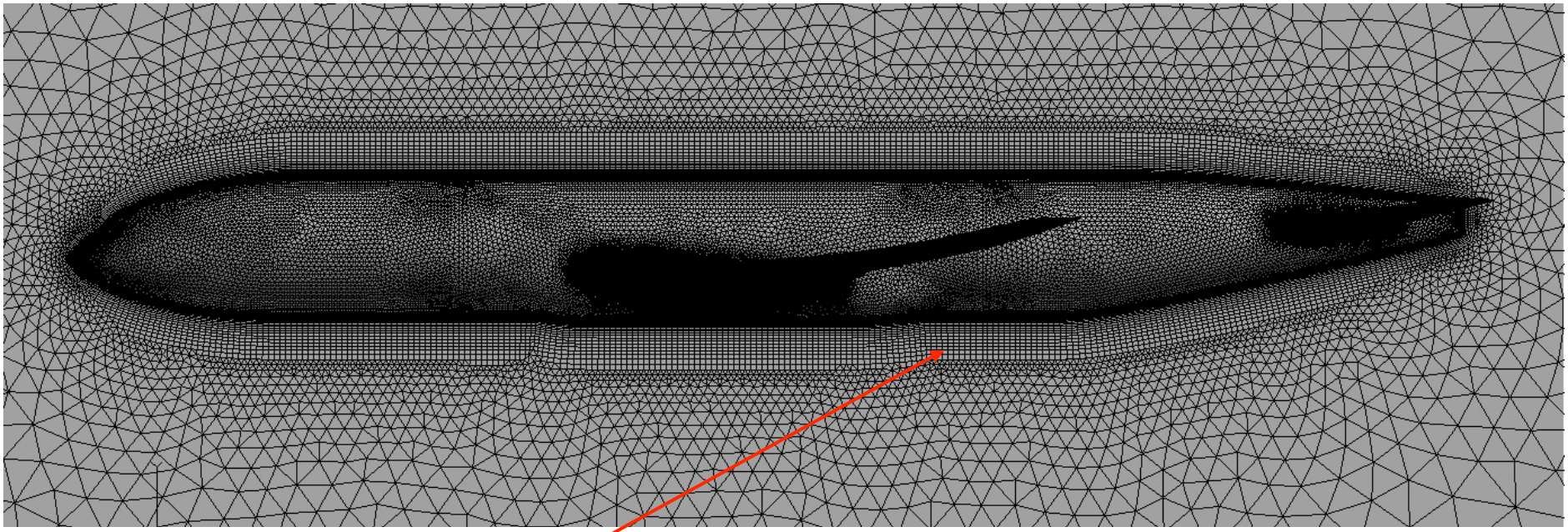

• AFLR builds prisms off the viscous surfaces, then transitions to tetrahedra once the cell aspect ratio is approximately 1

SUMMARY

- Created a suite of unstructured mixed-element grids using MADCAP/AFLR
- Grids range in size from 6M to 100+M cells
- Need more participants to run on the AFLR grids to determine their applicability to solvers other than BCFD
- Using BCFD, linear grid convergence was obtained using these grids
- Need to solve on the Boeing “best practice” grids and compare to the grids generated using the DPW guidelines