

Overset Grids for the NASA CRM WB & WBNP Aero-Elastic Configurations

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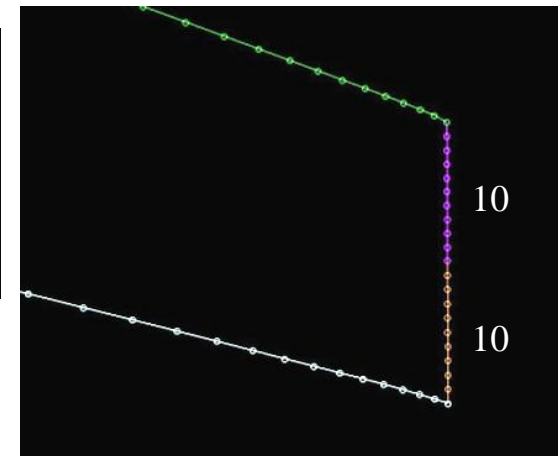
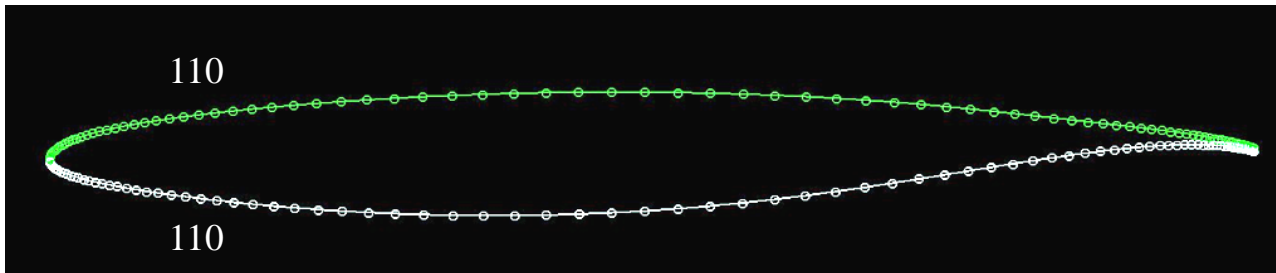
Outline: Baseline Overset Grids

- Grid Family Numerology
- Grid Topology
- Grid Generation Process
- Grid Images
- Grid Metrics
- Errata

[ftp://cmb24.larc.nasa.gov/outgoing/DPW6/
overset_grids_Boeing_Serrano.REV00/](ftp://cmb24.larc.nasa.gov/outgoing/DPW6/overset_grids_Boeing_Serrano.REV00/)

Grid Family Numerology (1/2)

- A requirement for approximately 1.5 X growth from one level to the next finer level was specified by the committee
- Since the cube root of 1.5 $\sim 1.15 \sim (8/7)$, this ratio was used to establish the growth between the Fine and X-Fine levels
- All grid segments in the coarse grid were factors of 5 x N where N is an even integer
 - For example, the wing airfoil has a total of 240 cells, with 110 on upper and lower surfaces and 20 on the TE base



Grid Family Numerology (2/2)

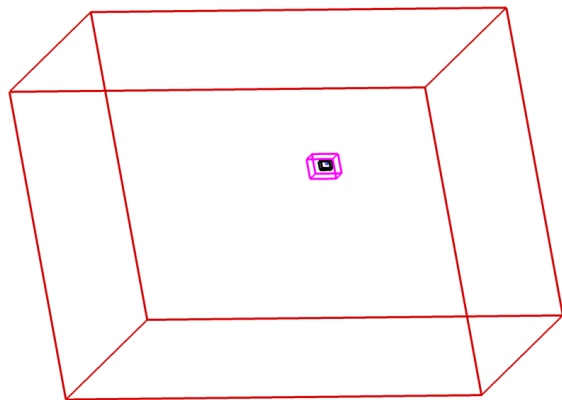
- Coarse Grid Generated First
- Family Generated using Following Factors

Level	Cell Dim	Growth Factor
Tiny	4 x N	
		$(5/4)^3 = 1.953$
Coarse	5 x N	
		$(6/5)^3 = 1.728$
Medium	6 x N	
		$(7/6)^3 = 1.588$
Fine	7 x N	
		$(8/7)^3 = 1.493$
eXtra-Fine	8 x N	
		$(9/8)^3 = 1.424$
Ultra-Fine	9 x N	

Where N is an even integer

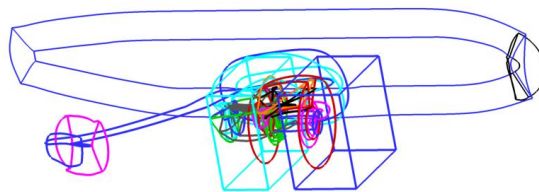
Grid Topology

The following wireframes illustrate zone topologies employed
(WBNP zones = 25; WB zones = 8)

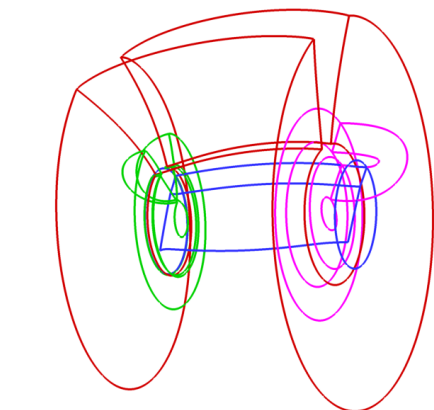
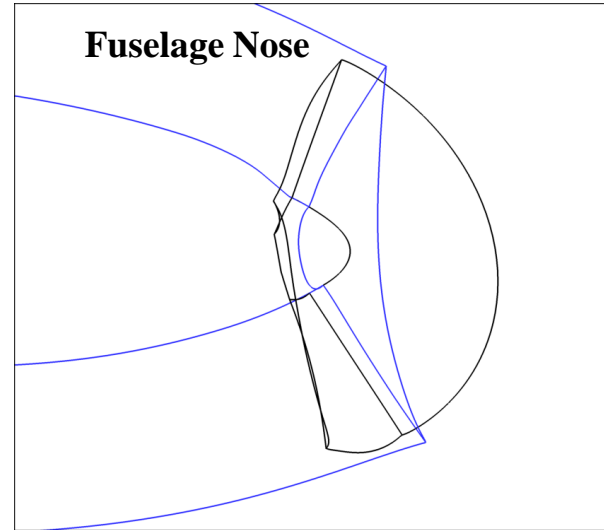


Farfield Boundary > 500 Crefs

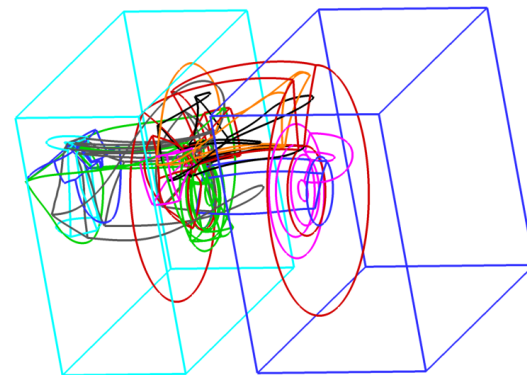
O-Grid Topology on Wing and Wing-Collar



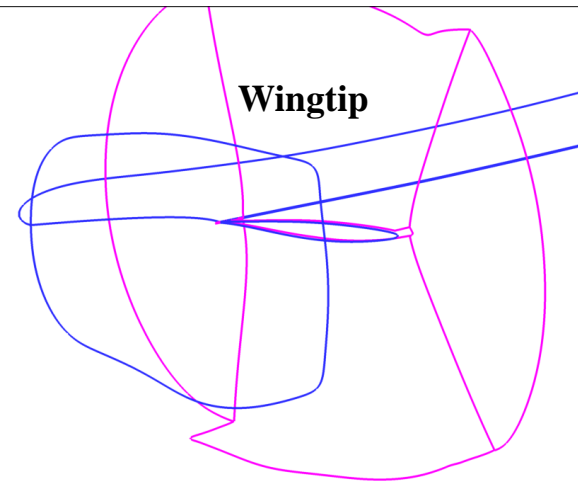
Fuselage Nose



Nacelle and Core Duct



Nacelle and Pylon System



Wingtip

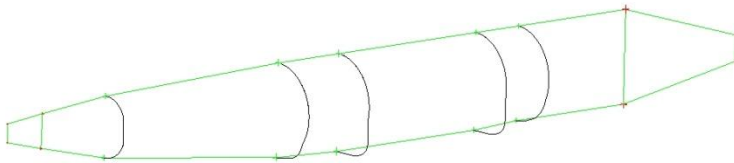
Grid Generation Process (1/3)

The grid generation process employed is based on two key cornerstones: ICEMCFD HEXA and NASA's Chimera Grid Tools (CGT), providing a high degree of automation

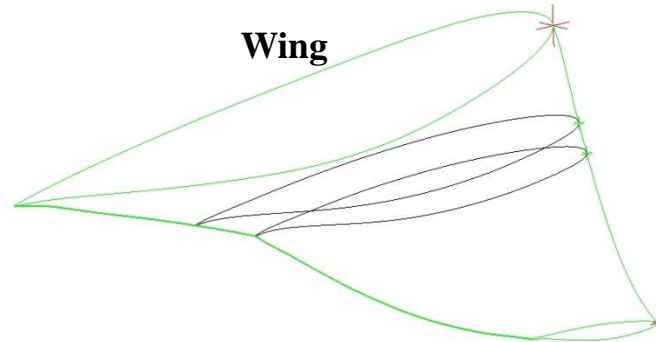
ICEMCFD 2D HEXA

- Used to generate all body fitted surface grids projected to geometry
- Used to generate the box volume grids

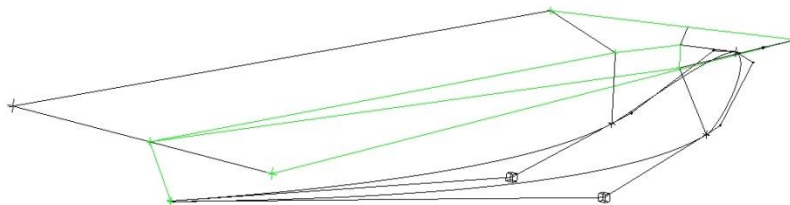
HEXA Body Blocking File



Wing



Pylon-Wing Collar



Grid Generation Process (2/3)

NASA's Chimera Grid Tools (CGT)

- Used config.tcl to manage configuration zones
- Used inputs.tcl to specify volume grid generation and grid coupling parameters
 - BUILDVOL Used to generate body fitted volume grids
 - BUILDPEG5i Used to hole-cut and couple grid

Additionally, custom TCL scripts based on CGT's scriptlib and ICEM replay files were used throughout the process

Grid Generation Process (3/3)

WBNP (ae2.75)

- Manually created 2D HEXA blocking files for each body fitted grid
- Used custom TCL script to generate the family of WBNP grids
 - Automatically scaled number of points and end spacings on HEXA blocking file to generate new surface grids
 - Automatically ran BUILDVOL and BUILDPEG5i with appropriate scaling factors (e.g., offset, viscous spacing)

WB (ae2.75) Grid Family Created from WBNP Grids

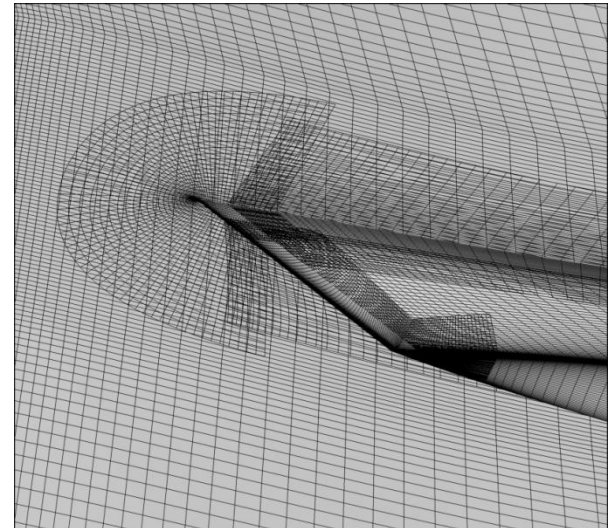
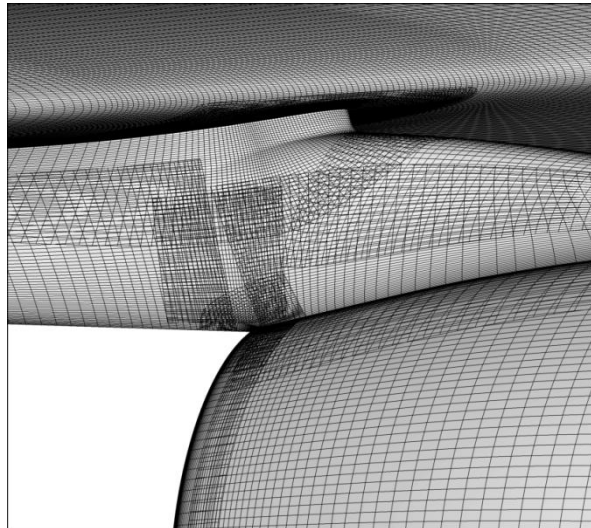
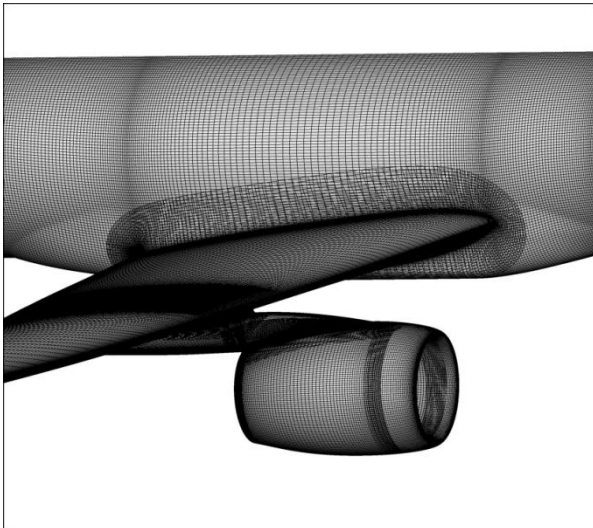
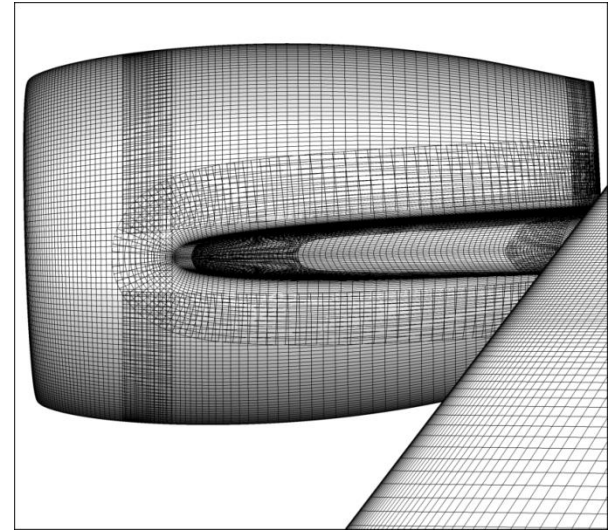
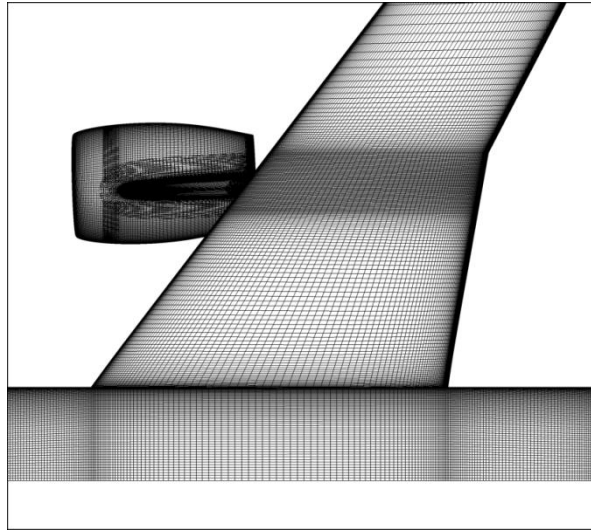
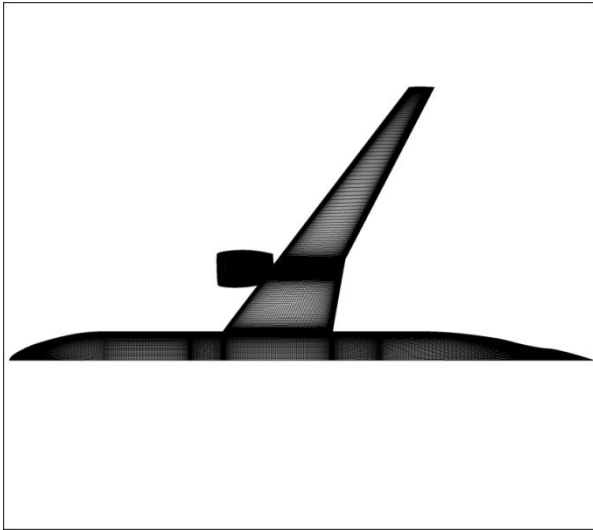
- TCL script extracted applicable volume zones and ran BUILDPEG5i

WB Deflected Medium Grid Models

- Manually updated blocking file on each deflected geometry
 - Minimal effort; process could have been scripted

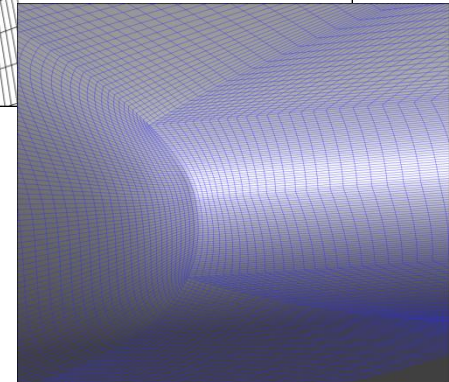
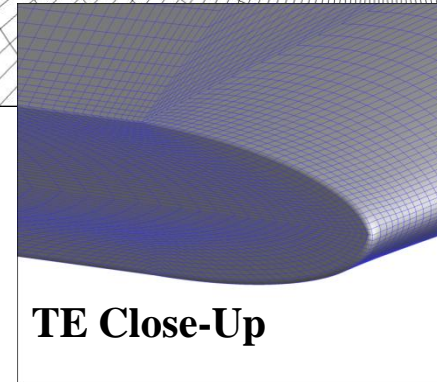
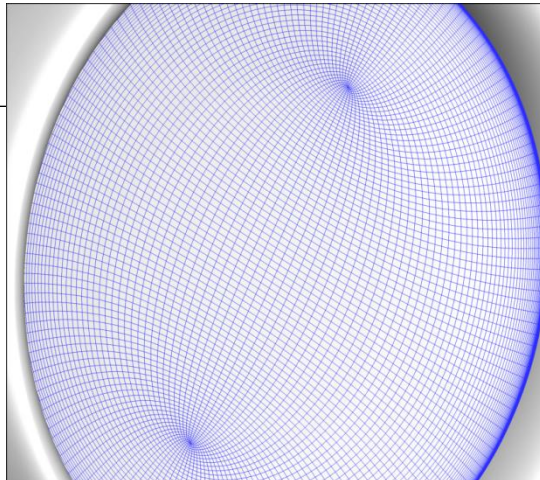
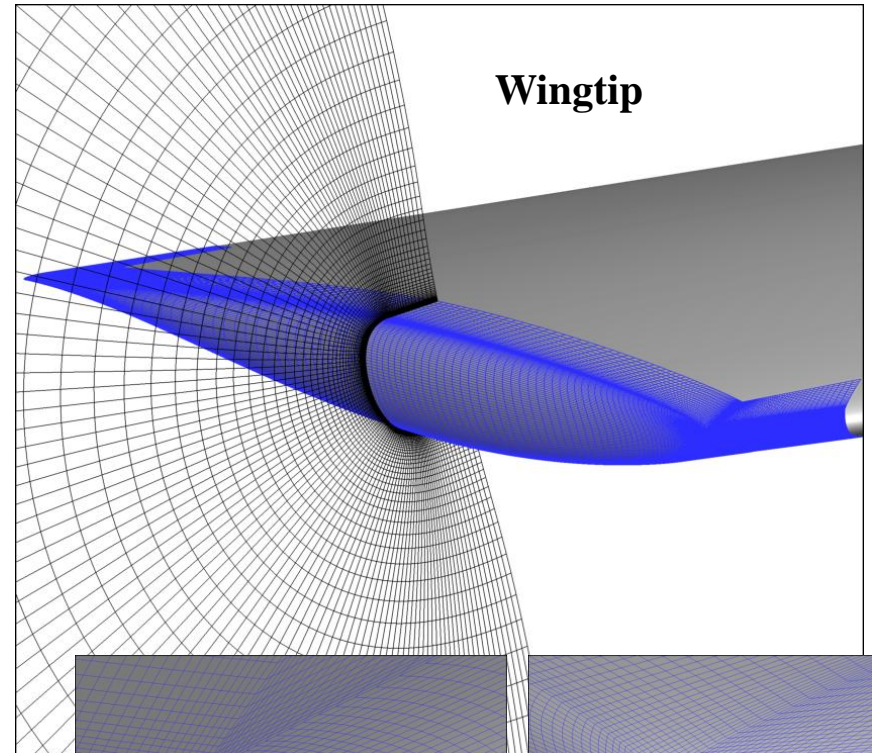
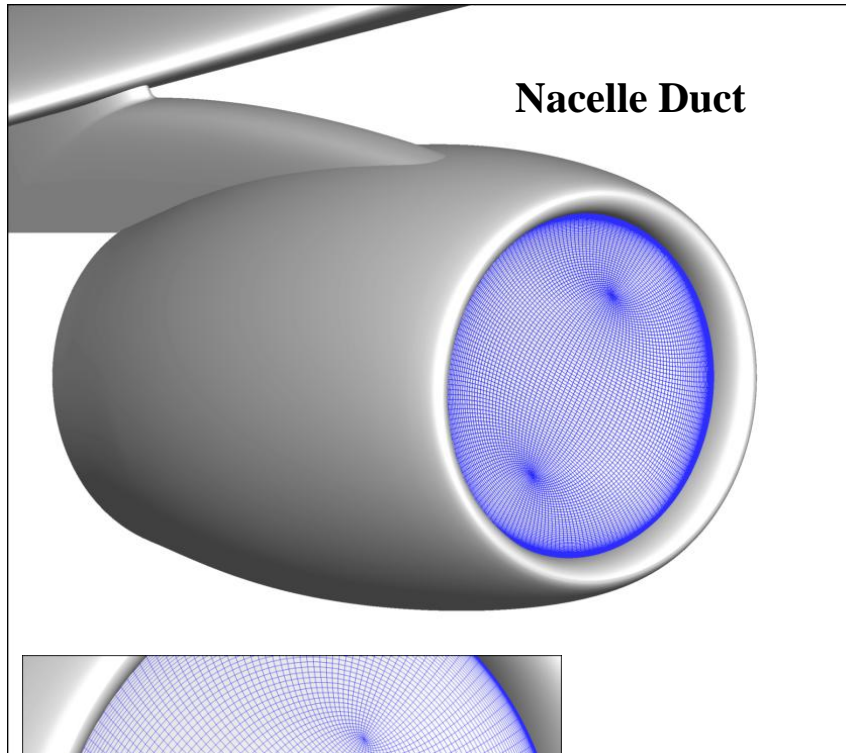
Mesh Images (1/3)

Medium Grid



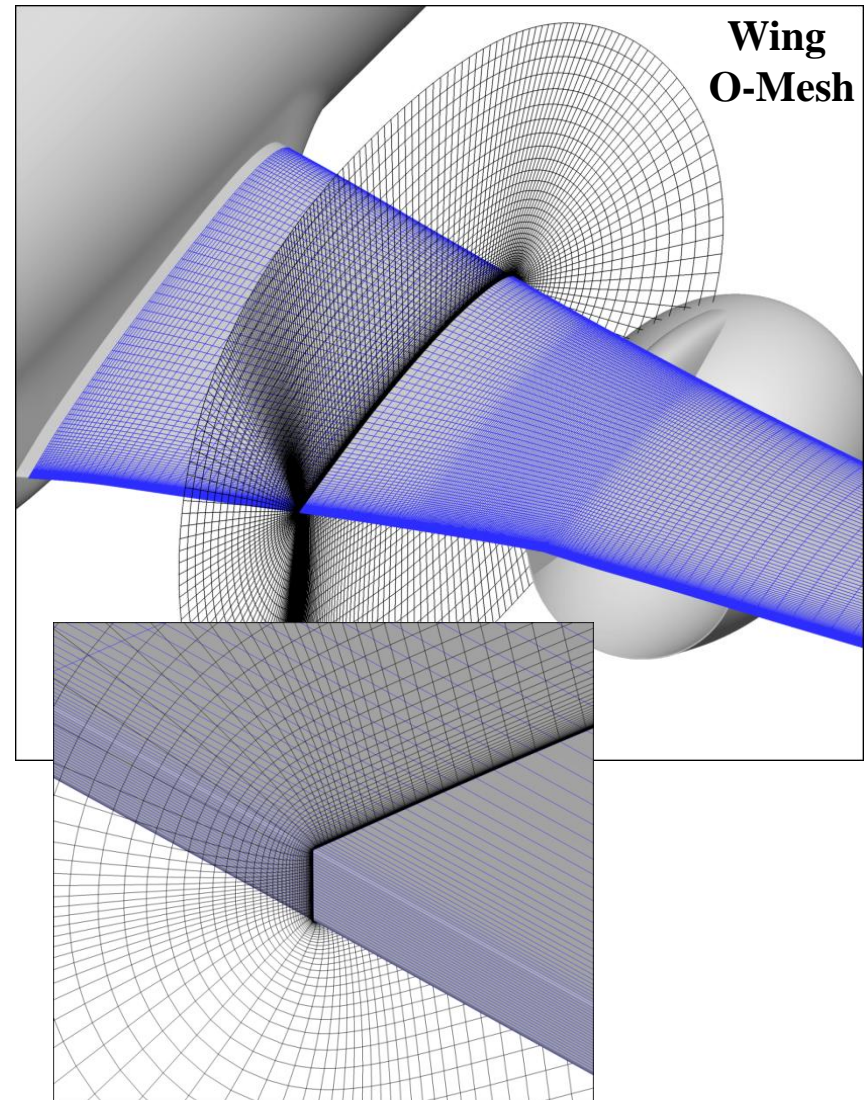
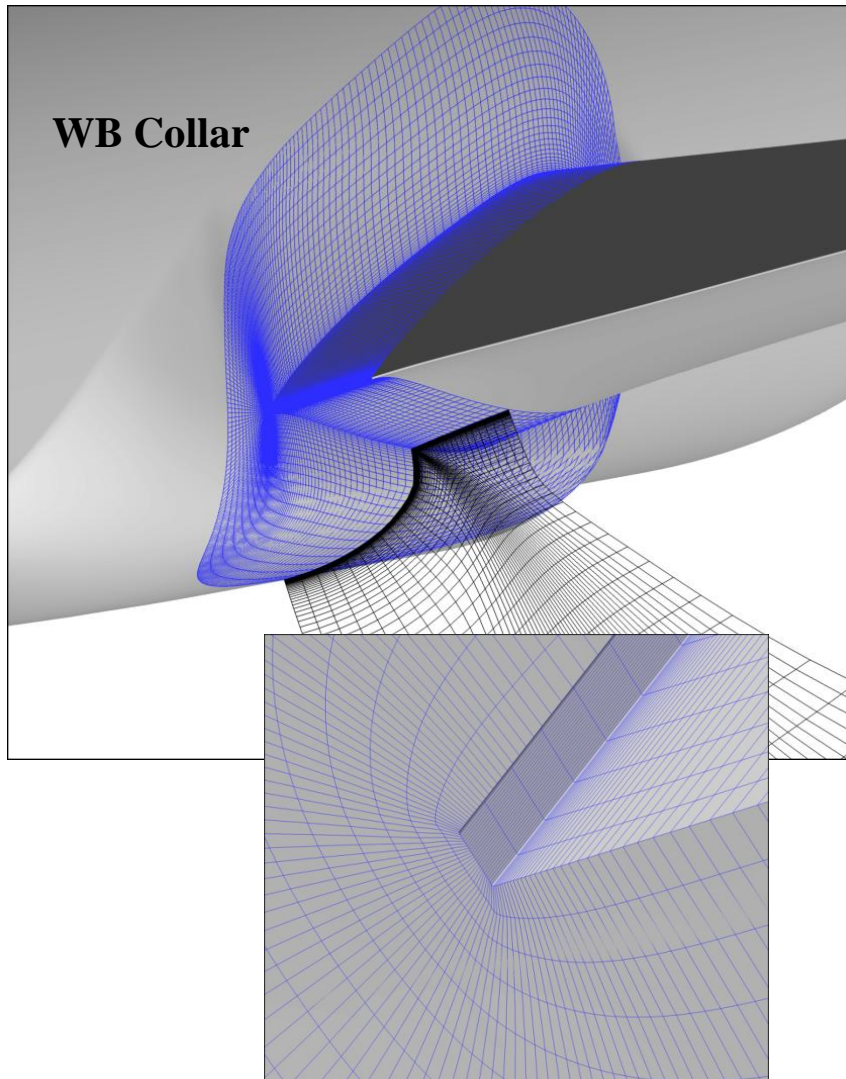
Mesh Images (2/3)

Medium Grid



Mesh Images (3/3)

Medium Grid



TE Close-Ups

Grid Metrics (1/3)

Nominal values for body fitted volume grids

Grid	Viscous Spacing	$\sim y^+$	# Constant Cells at Wall	Maximum Stretching
Tiny	0.001478	1.02	4	1.235
Coarse	0.001182	0.80	5	1.186
Medium	0.0009853	0.67	5	1.149
Fine	0.0008446	0.58	6	1.128
X-fine	0.0007390	0.50	7	1.112
U-fine	0.0006569	0.45	8	1.099

Grid Metrics (2/3)

WB (ae2.75) Grid Family: 8 zones

U-fine/Tiny ~ 11.2 X

Grid	Grid Points	Orphans
Tiny	7,398,176	0
Coarse	14,355,678	0
Medium	24,698,828	0
Fine	39,098,858	0
X-fine	58,227,000	0
U-fine	82,754,486	0

Grid Metrics (3/3)

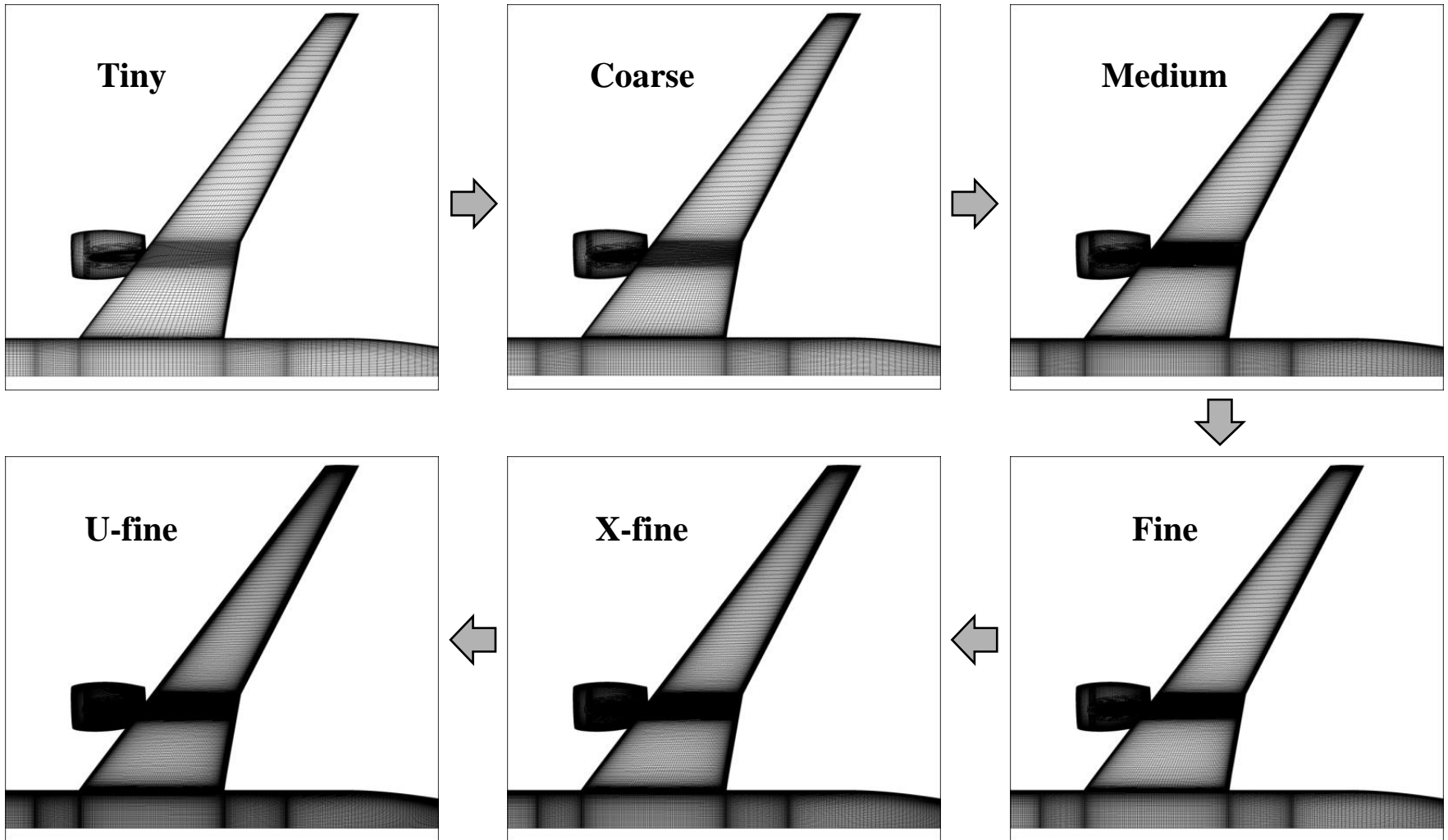
WBNP (ae2.75) Grid Family: 25 zones

WBNP/WB ~ 1.6 X

Grid	Grid Points	Orphans
Tiny	11,865,177	5
Coarse	22,999,565	6
Medium	39,542,953	3
Fine	62,566,221	3
X-fine	93,176,522	4
U-fine	132,381,764	1

Family Surface Grid Density Variation

Model ae2.75

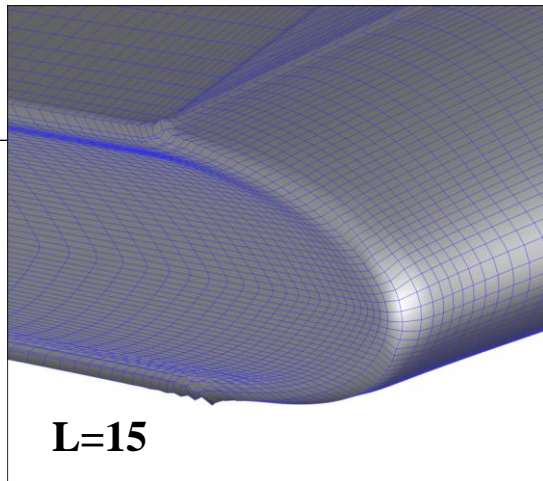
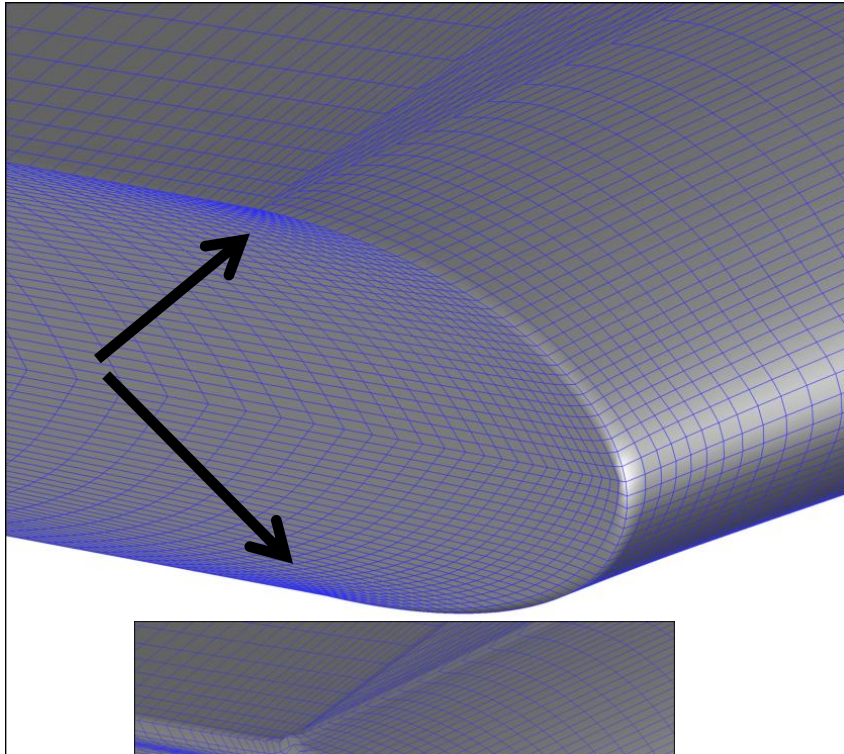


Grid Errata re “Rev00” (1/2)

Wingtip TE Cap Region

ae3.00 & ae3.50

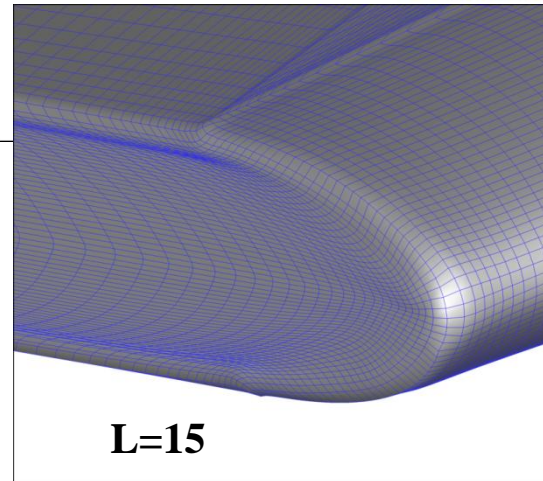
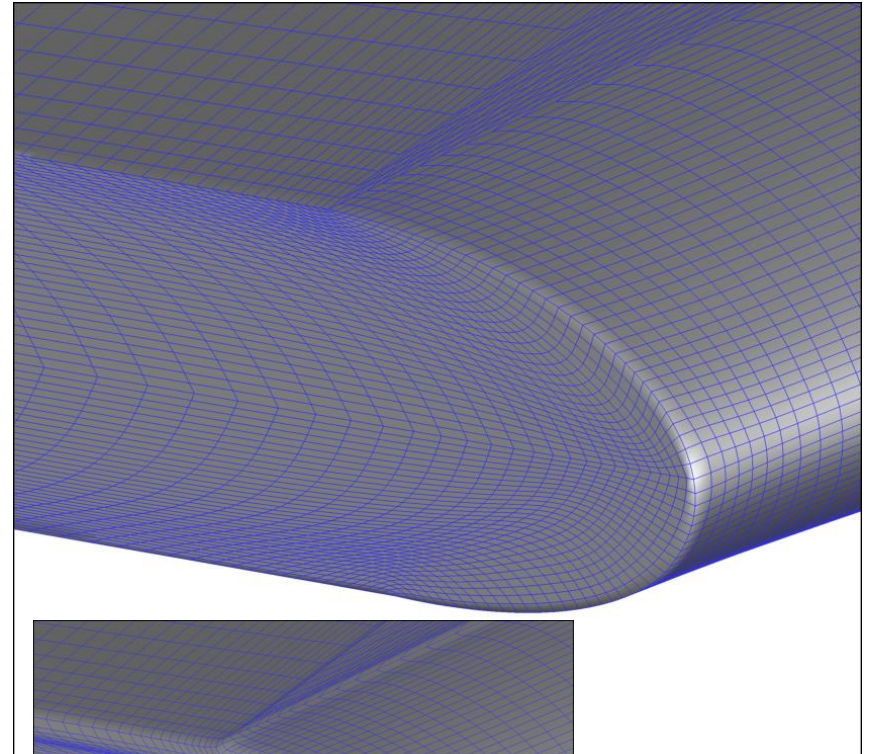
Failed to smooth topology corners



L=15

Updated Grid “Rev01”

(ae3.50 shown)

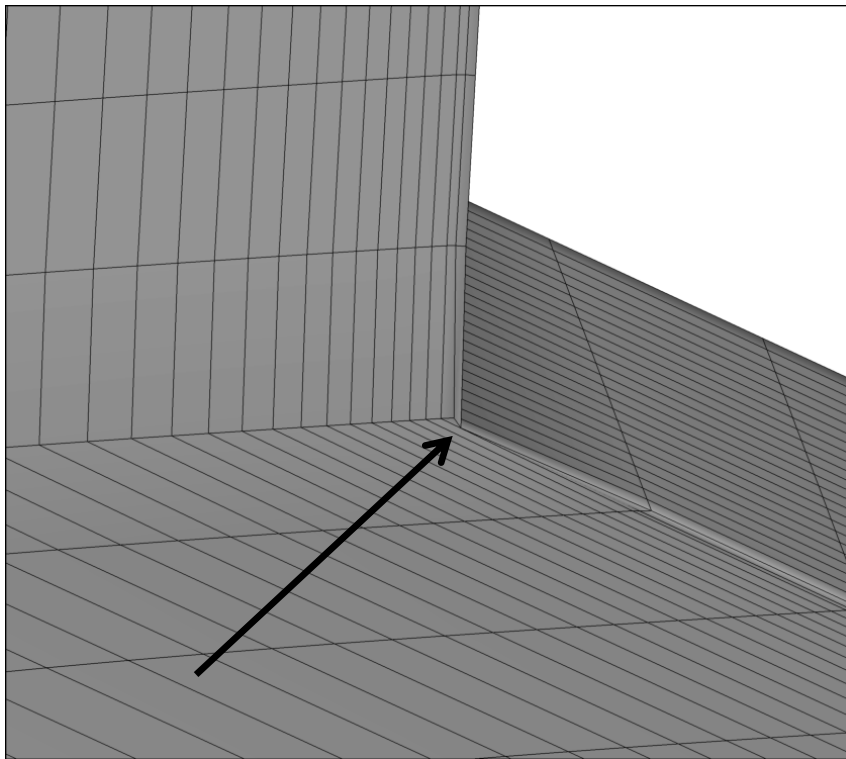


L=15

Grid Errata re “Rev00” (2/2)

Wing TE Break (ae3.50)

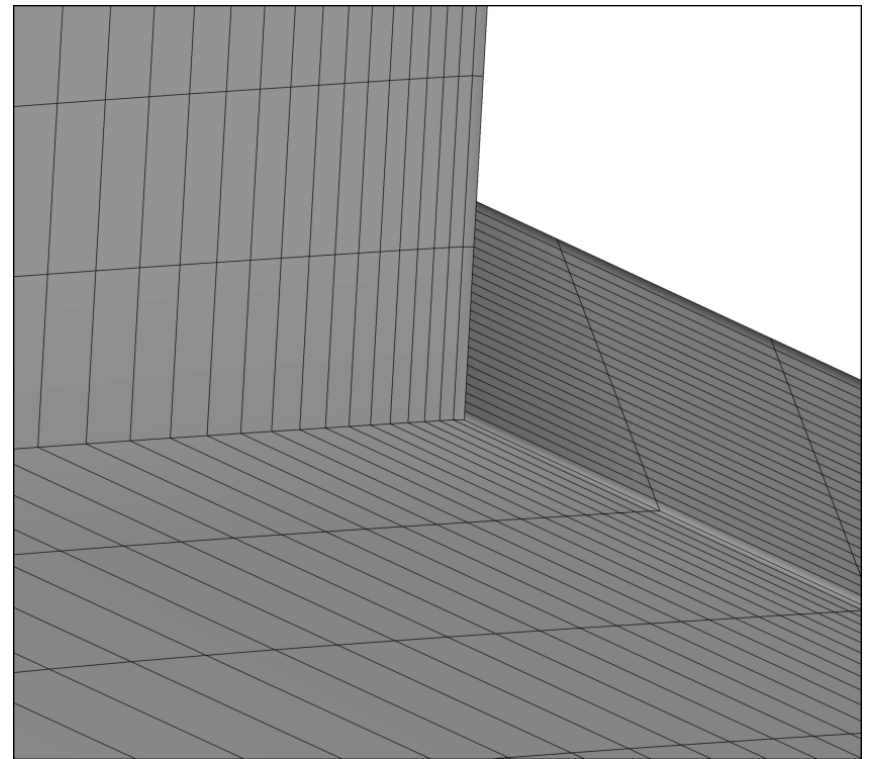
Failed to project block vertex to correct geometry point, creating micro lip at lower surface



Vertical distance offset at **the one** affected surface grid point ~ 0.017"

Updated grid “Rev01”

Problem occurred by failing to update block vertex-point association



Thank You!