



Applied Aerodynamics  
Technical Committee

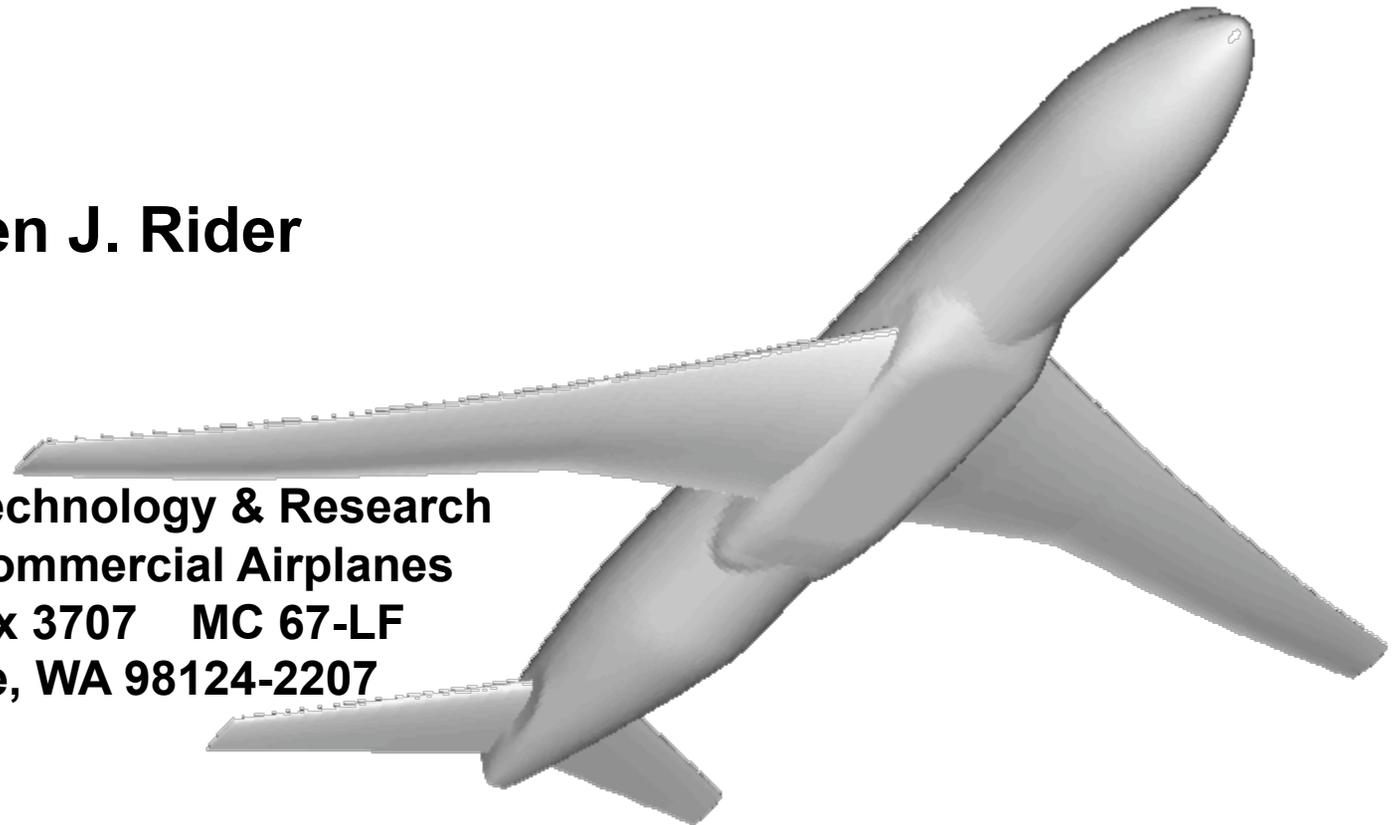
**4th CFD Drag Prediction Workshop**  
San Antonio, Texas – June 2009

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# Structured Grid Summary for the 4<sup>th</sup> Drag Prediction Workshop

**Ben J. Rider**

**Enabling Technology & Research  
Boeing Commercial Airplanes  
P.O. Box 3707 MC 67-LF  
Seattle, WA 98124-2207**





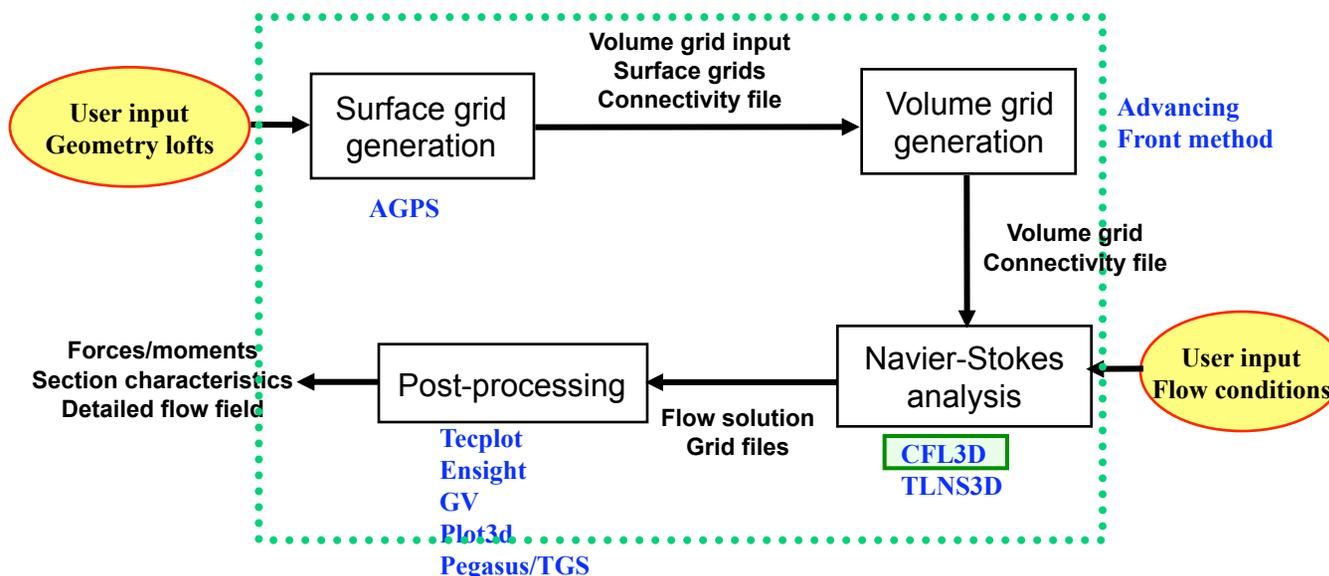
# 4th CFD Drag Prediction Workshop

## San Antonio, Texas – June 2009

<b>Structured Grids</b>					
Symbol Key	Company	Code	Grid Type	Grid Generator	Turb Model
L	Boeing Seattle*	CFL3D	Multiblock/Structured	Zeus	S-A
M	Boeing Seattle*	CFL3D	Multiblock/Structured	Zeus	SST k-w
N	Boeing Seattle*	CFL3D	Multiblock/Structured	Zeus	S-A
O	Boeing Seattle*	CFL3D	Multiblock/Structured	Zeus	SST k-w
Y	ONERA	struc/finite volume	Multiblock/Structured	Zeus	S-A
A	CFS	NSMB	Multiblock/Structured	ICEM Hexa	SST k-w
R	ANSYS	Fluent	Multiblock/Structured	ICEM Hexa	SST k-w
V	Airbus	elsA	Multiblock/Structured	ICEM Hexa	SST k-w
H	JAXA	UPACS	Multiblock/Structured	Gridgen	S-A mod
U	ZeusNumerix	HLLC	Multiblock/Structured	GridZ	S-A
P	Boeing HB	OVERFLOW	Overset	MADCAP/HYPGEN	S-A

## Boeing ZEUS/CFL3D Example

### Driver for Surface Grid Generation, Volume Grid Generation, Navier-Stokes Analysis, and Post-processing

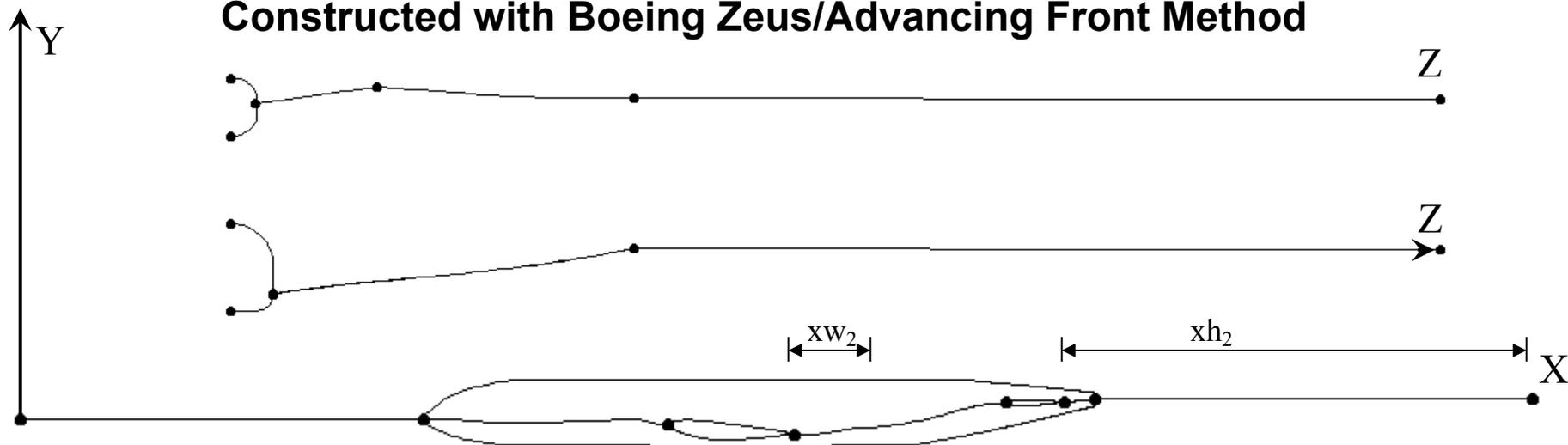


#### Acknowledgement

None of this work would have been possible without the considerable contributions of:

N. Jong Yu  
Tsong-Jhy Kao  
Margaret M. Curtin

## Structured Multi-Block Wing-Body Grids Constructed with Boeing Zeus/Advancing Front Method



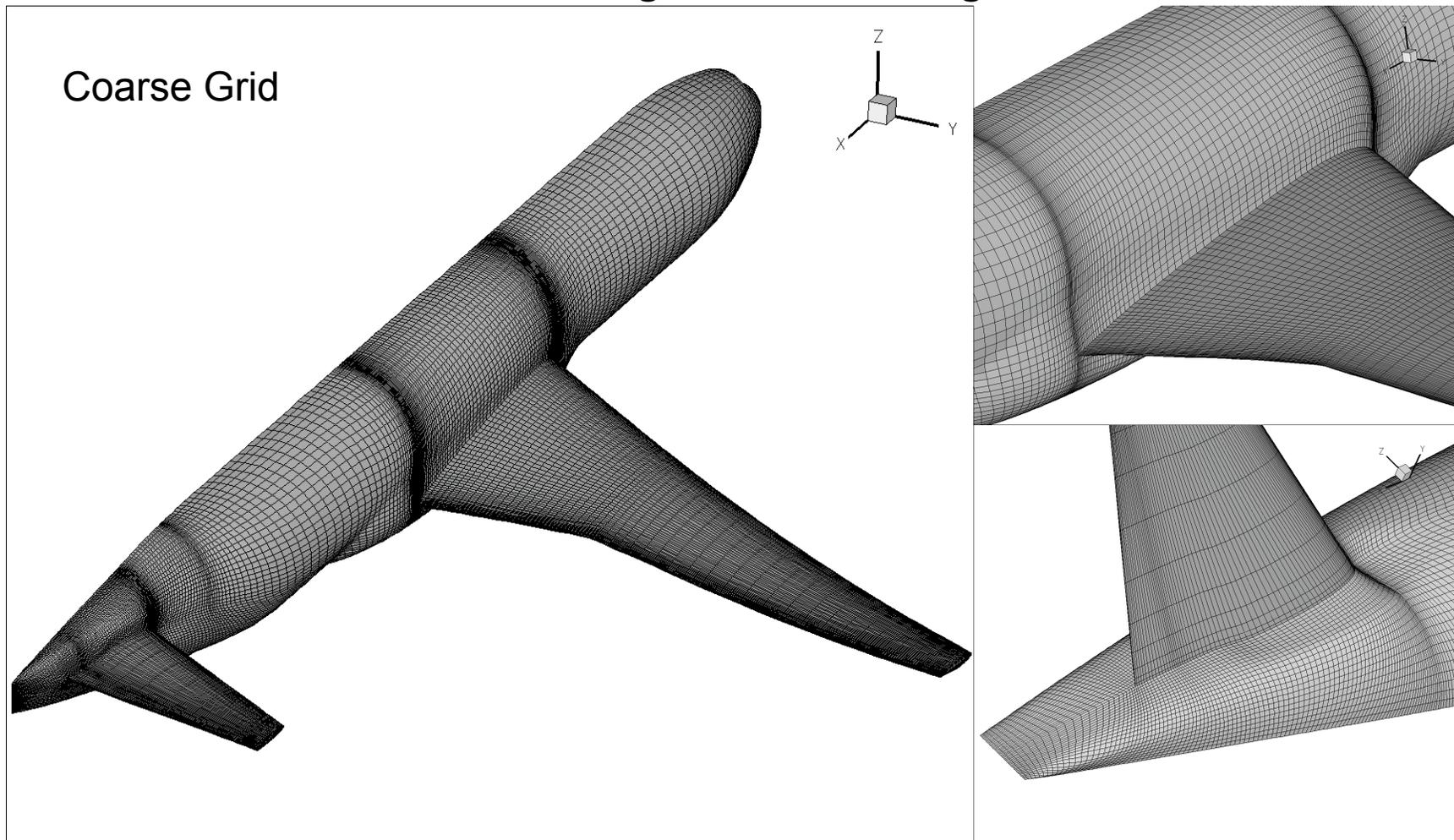
	X total	Y total	Z total
Coarse: 5M RE	377	65	97
Medium: 5M RE	469	81	145
Medium-Fine: 5M RE	657	97	201
Fine: 5M RE	873	105	257
Medium: 20M RE	469	81	145

Boundary Layer	$\Delta y_1$	Ave $y^+$
Coarse: 5M RE	0.000835530	0.5652
Medium: 5M RE	0.000835530	0.5652
Medium-Fine: 5M RE	0.000557020	0.3768
Fine: 5M RE	0.000417765	0.2826
Medium: 20M RE	0.000139255	0.33975

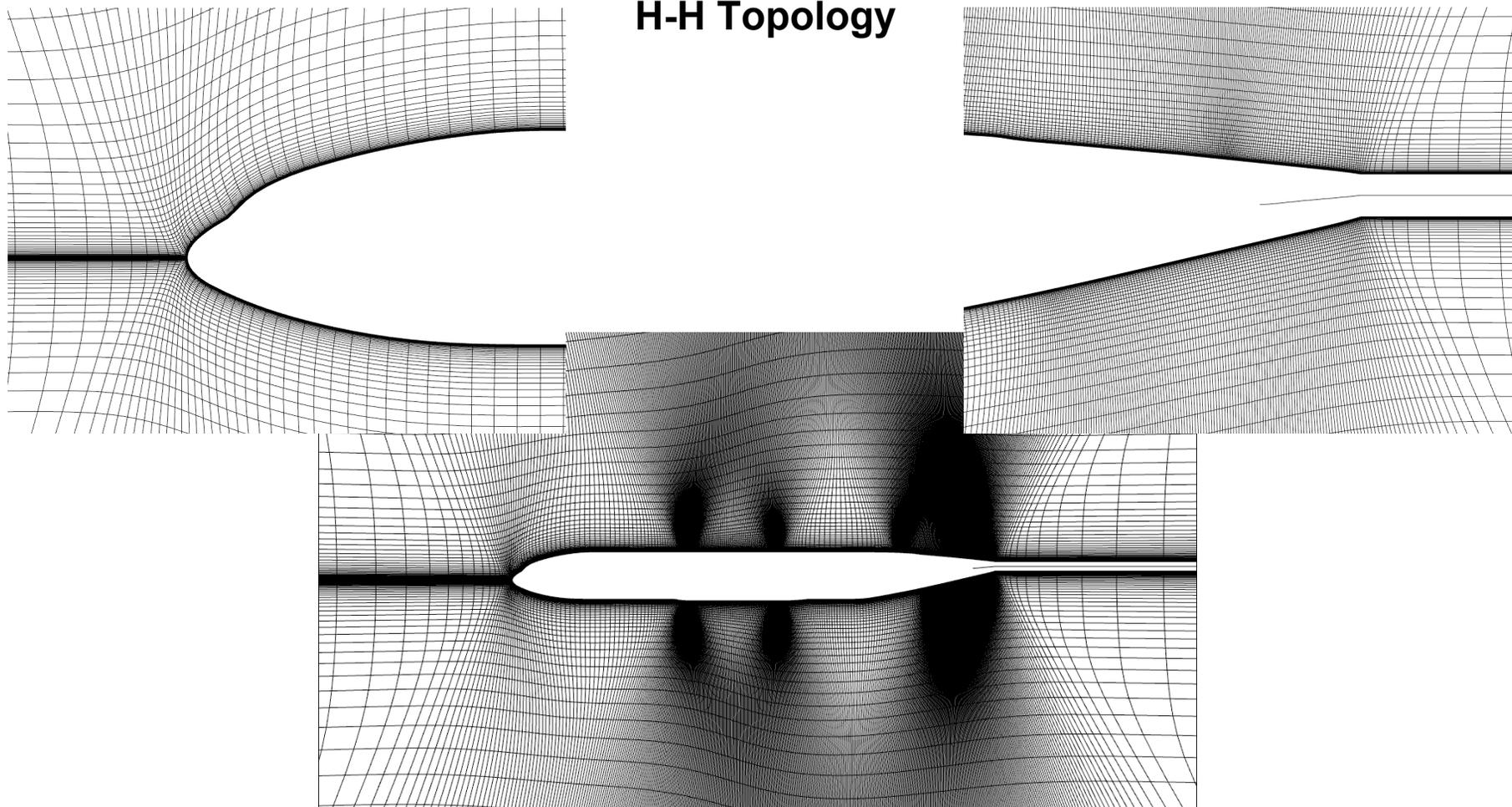
Blunt TE	xw2	xh2	Y
Coarse: 5M RE	25	41	57
Medium: 5M RE & 20M RE	25	57	65
Medium-Fine: 5M RE	25	81	73
Fine: 5M RE	25	101	81

Total Grid Size	Grid Cells
Coarse: 5M RE	4.8M
Medium: 5M RE & 20M RE	11.0M
Medium-Fine: 5M RE	25.7M
Fine: 5M RE	47.2M

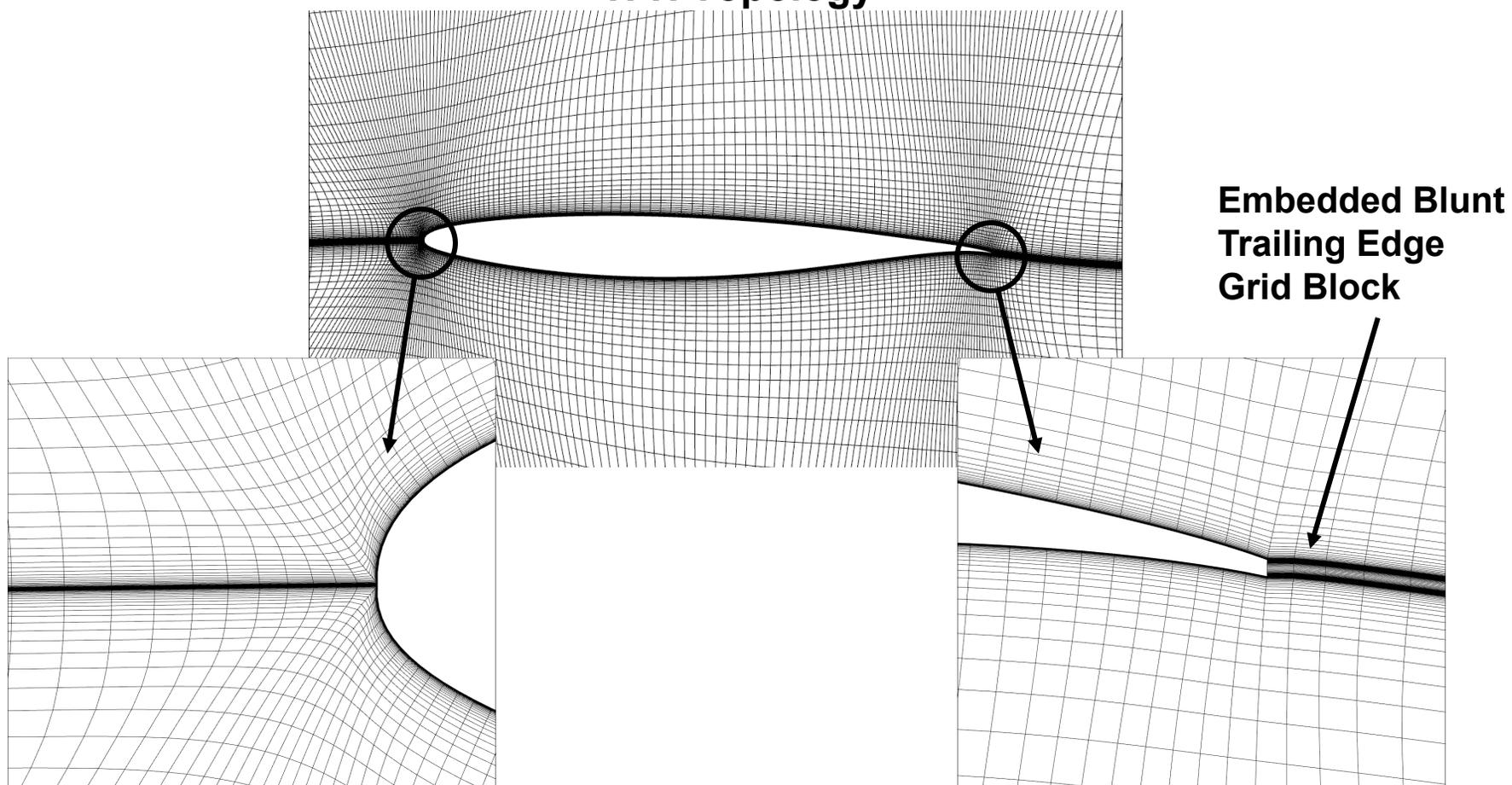
## Structured Multi-Block Wing-Body Grids Constructed with Boeing Zeus/Advancing Front Method



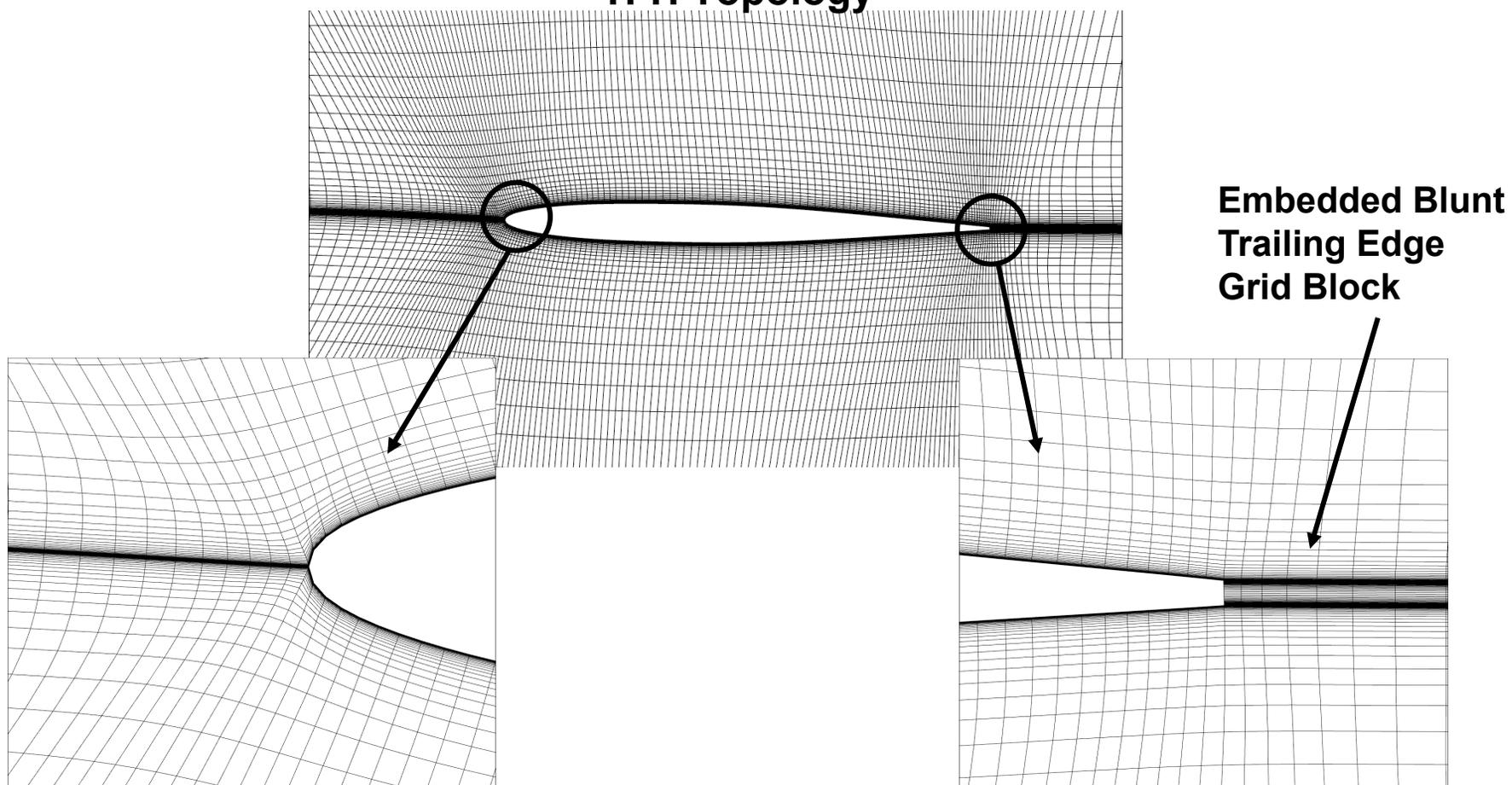
## Typical Medium Grid: K-plane cut Symmetry plane H-H Topology



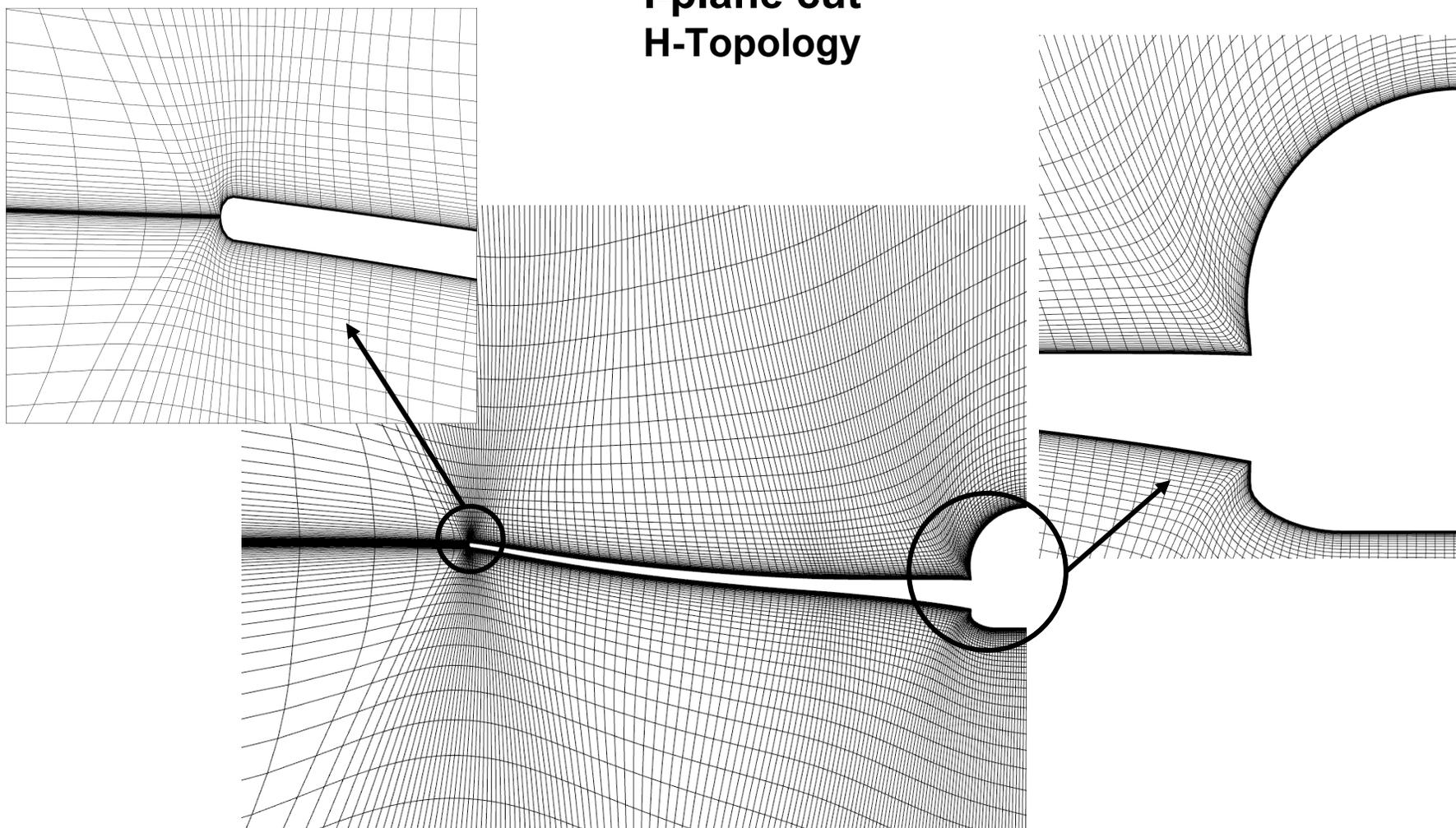
## Typical Medium Grid Wing K-plane cut H-H Topology



## Typical Medium Grid Horizontal K-plane cut H-H Topology

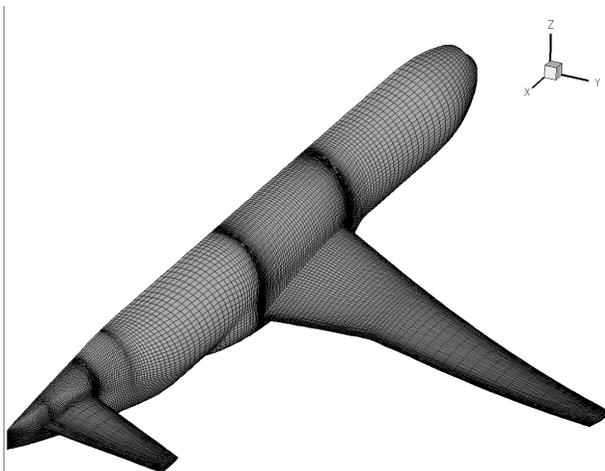


## Typical Medium Grid I-plane cut H-Topology

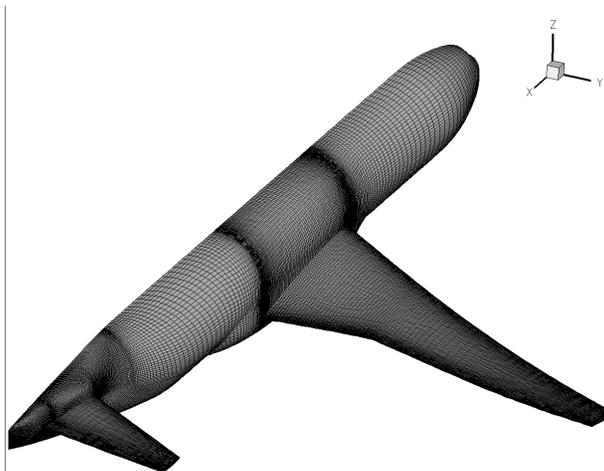


## Case 1a: Grid Refinement Study

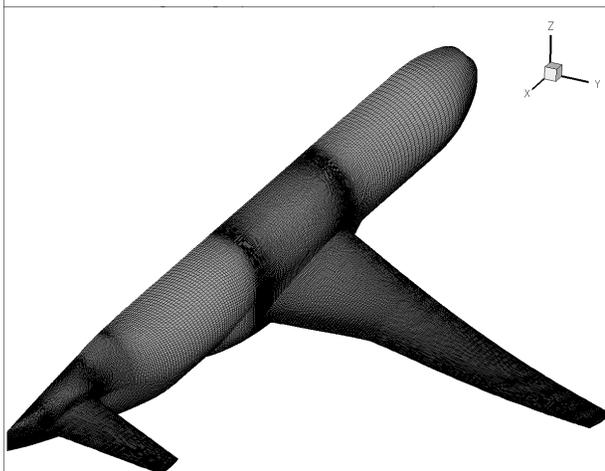
Coarse  
Grid



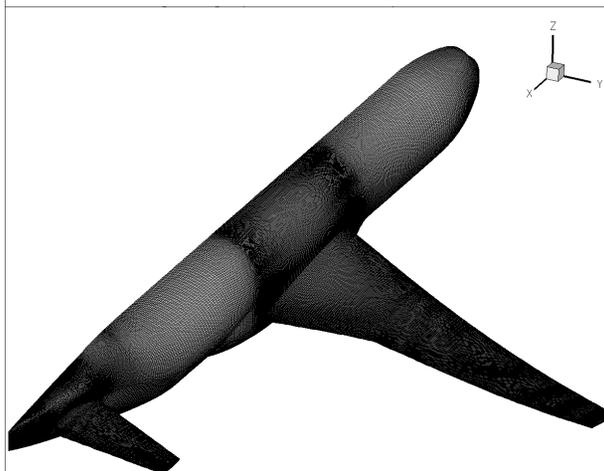
Medium  
Grid



Medium-Fine  
Grid

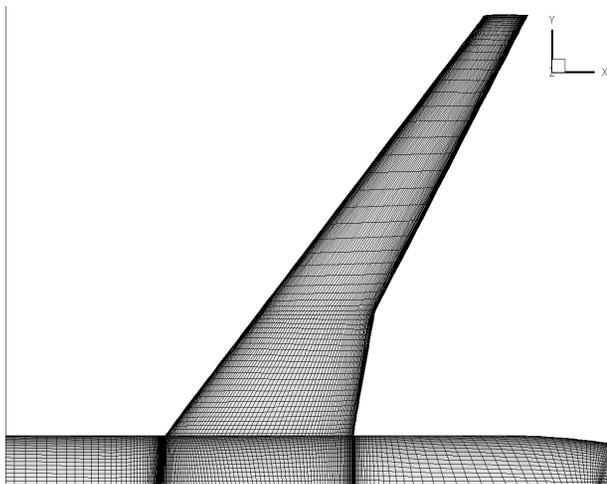


Fine  
Grid

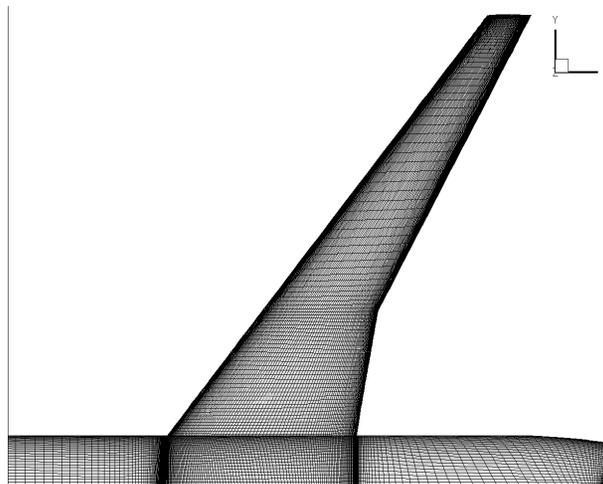


## Case 1a: Grid Refinement Study

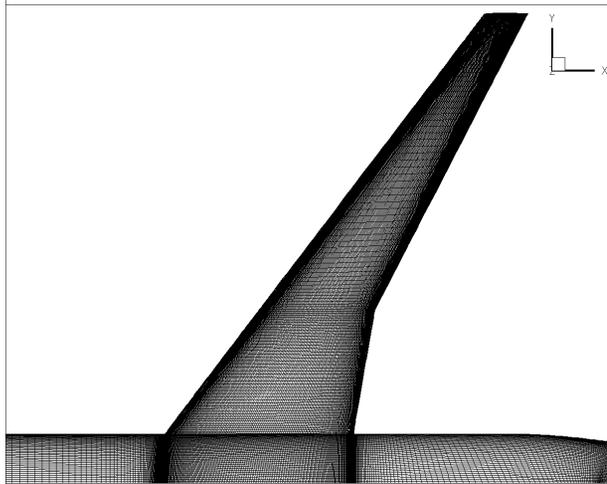
Coarse  
Grid



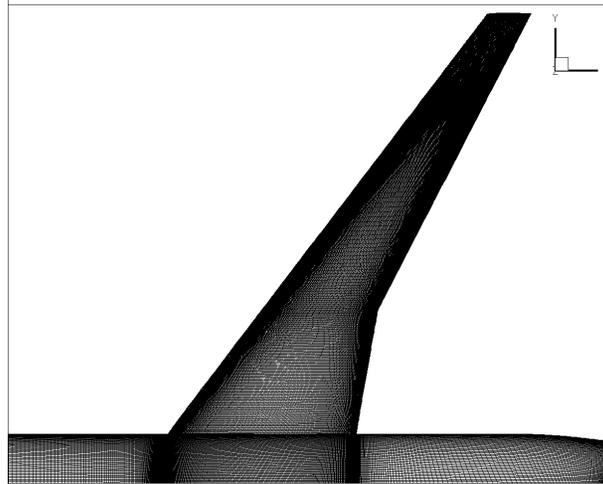
Medium  
Grid



Medium-Fine  
Grid

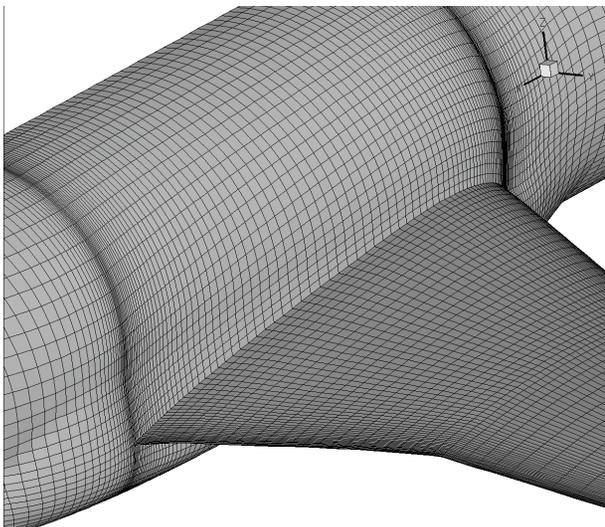


Fine  
Grid

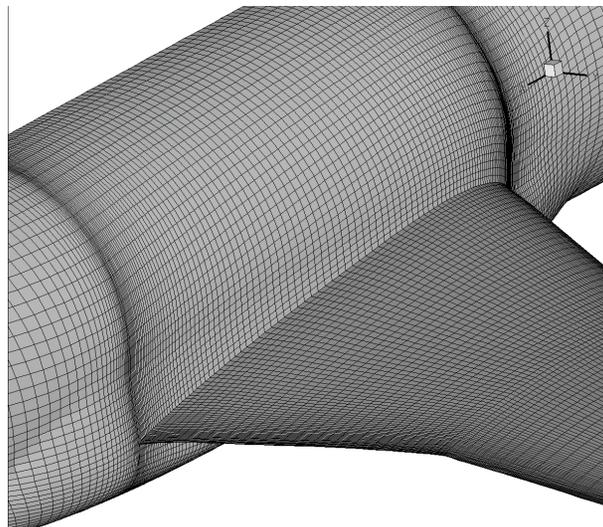


## Case 1a: Grid Refinement Study

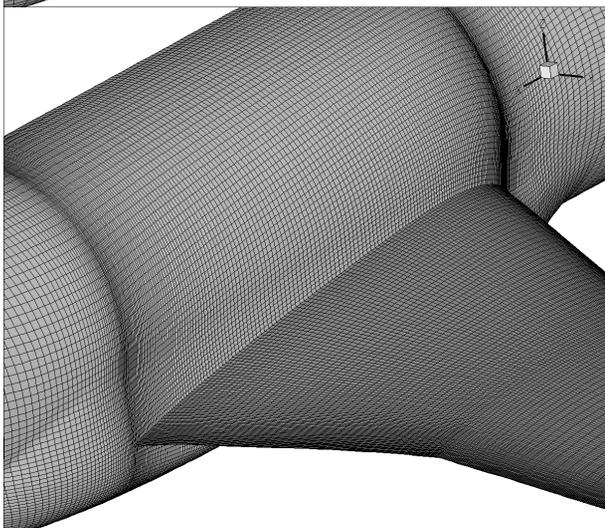
Coarse  
Grid



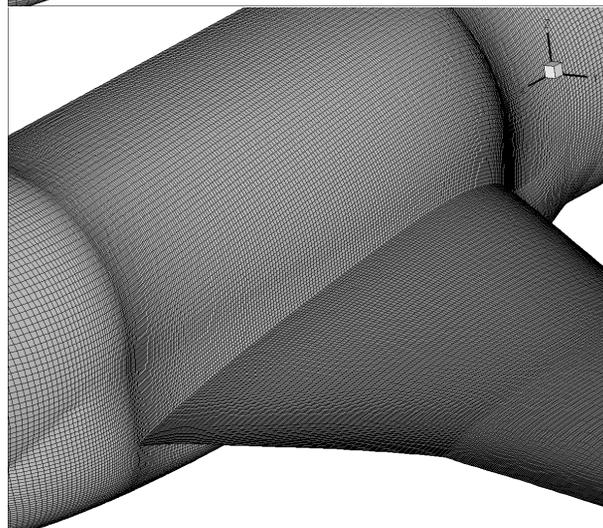
Medium  
Grid



Medium-Fine  
Grid

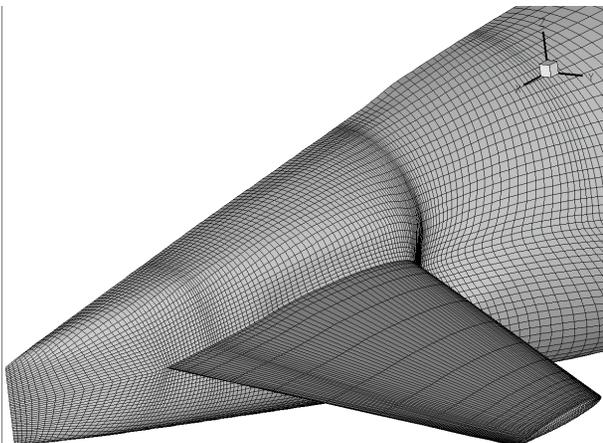


Fine  
Grid

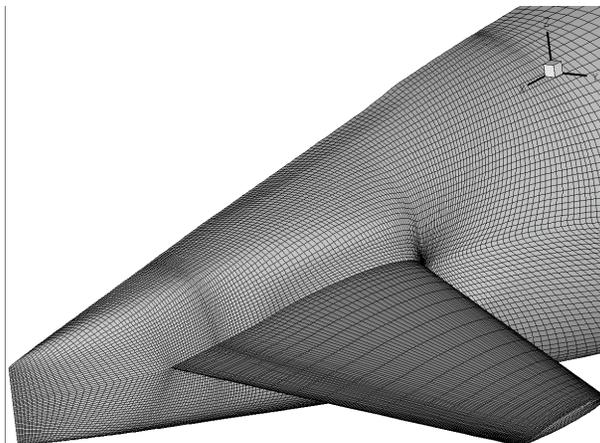


## Case 1a: Grid Refinement Study

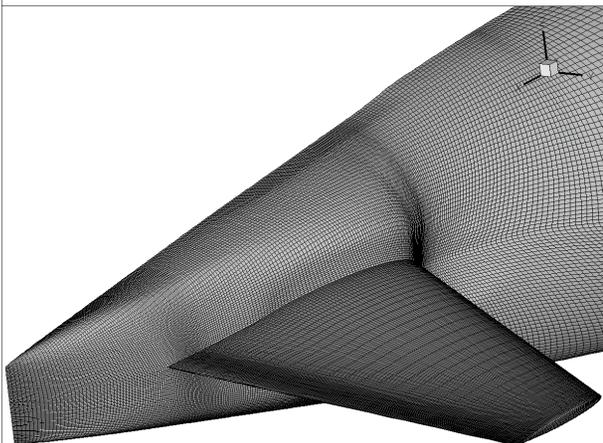
Coarse  
Grid



Medium  
Grid



Medium-Fine  
Grid

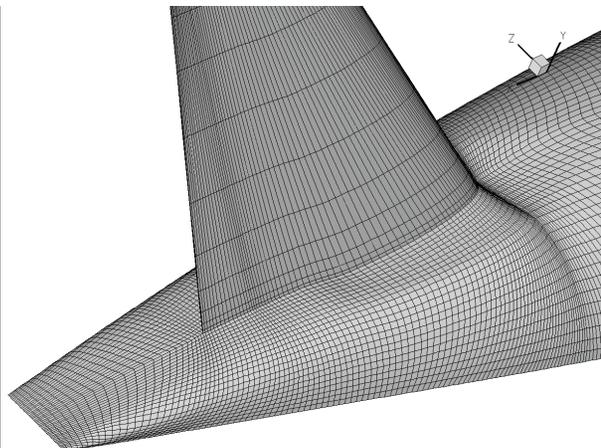


Fine  
Grid

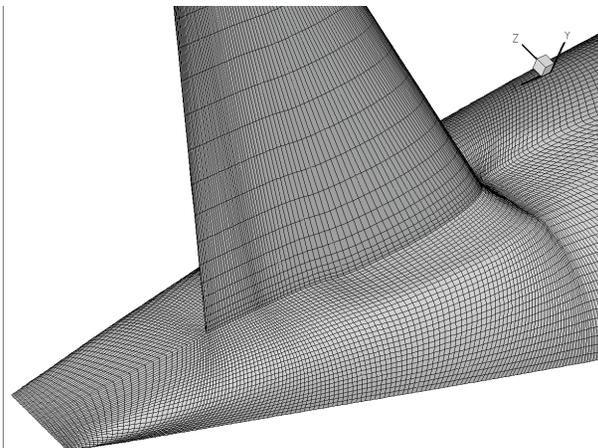


## Case 1a: Grid Refinement Study

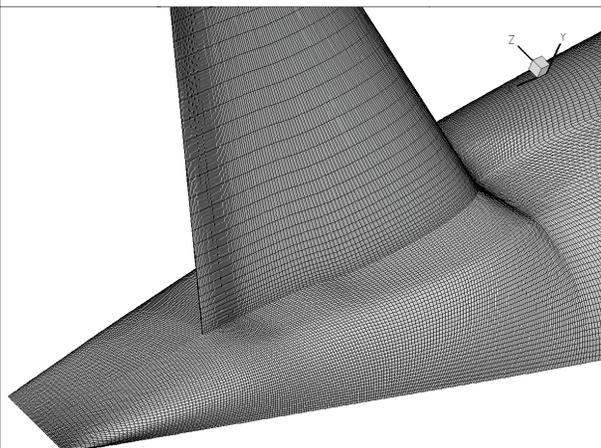
Coarse  
Grid



Medium  
Grid



Medium-Fine  
Grid



Fine  
Grid

