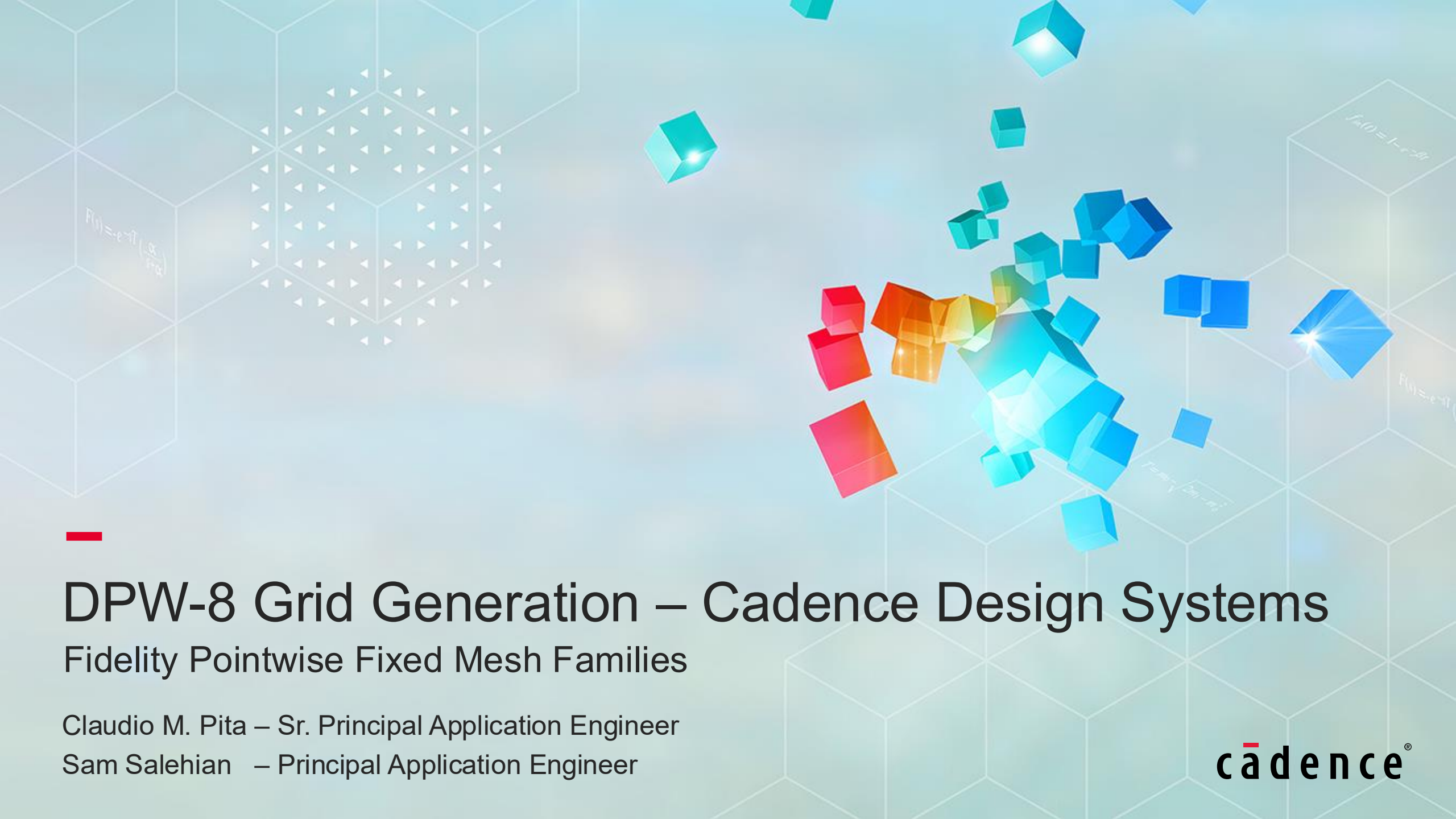




DPW-8 Grid Generation – Cadence Design Systems

Fidelity Pointwise Fixed Mesh Families

Claudio M. Pita – Sr. Principal Application Engineer

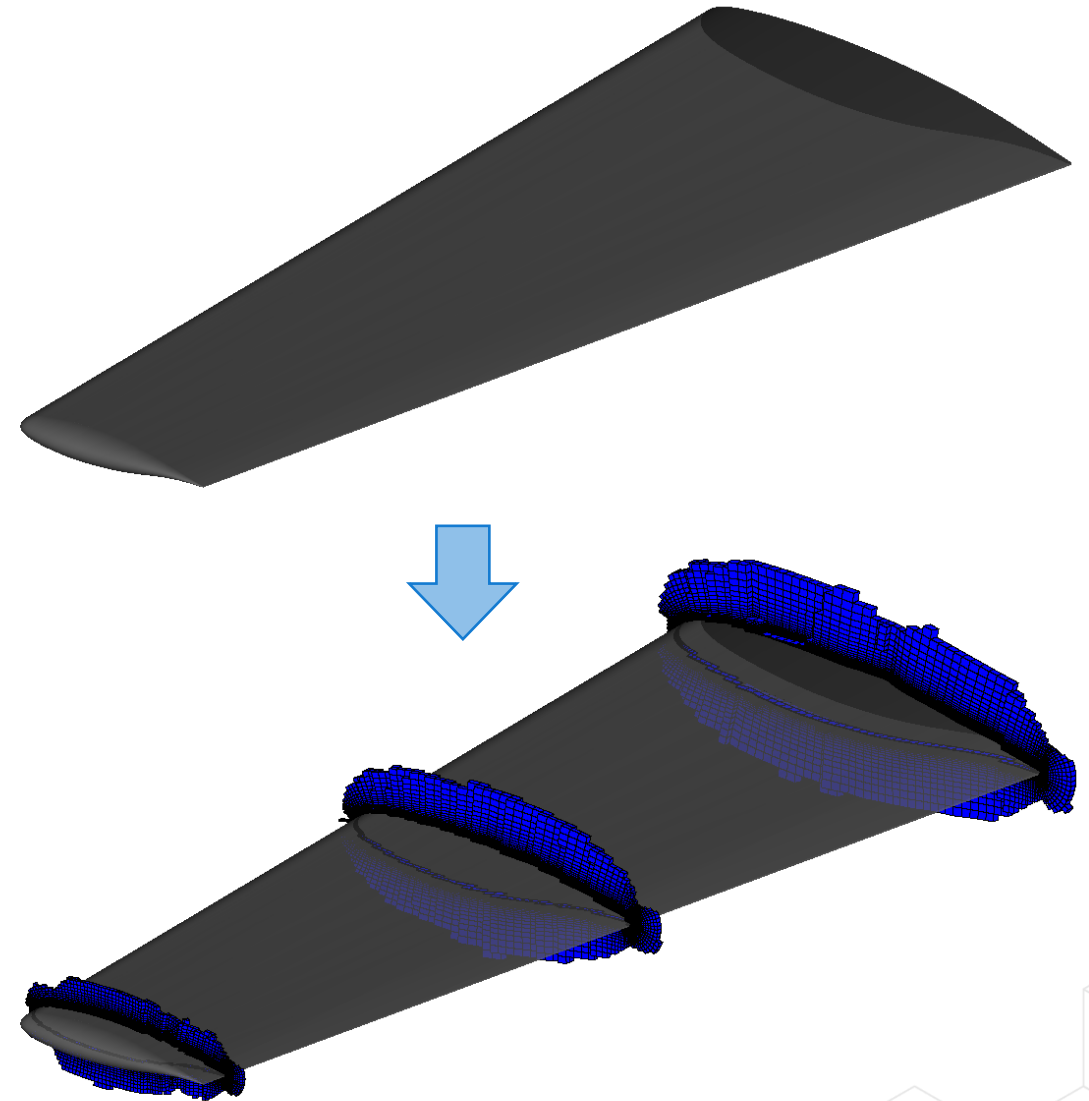
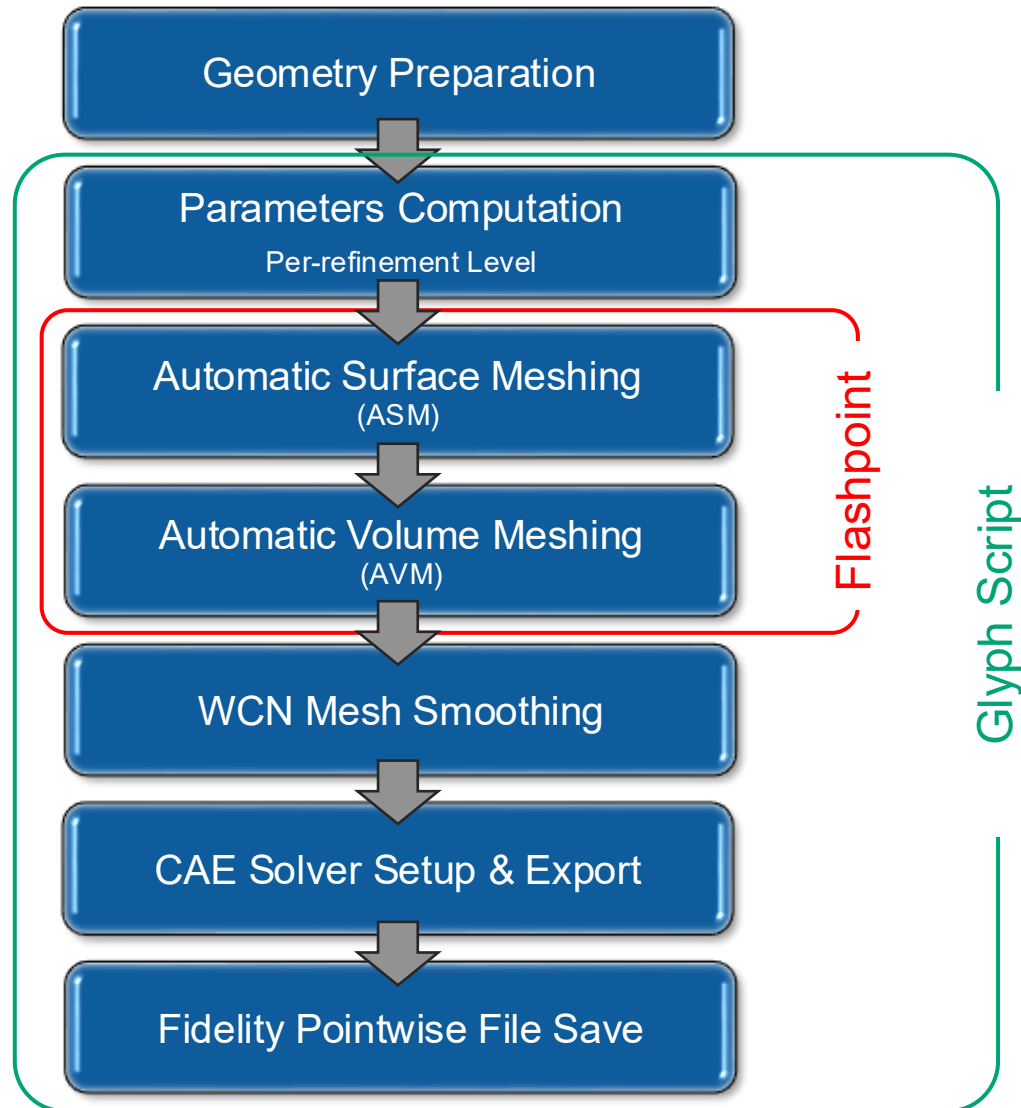
Sam Salehian – Principal Application Engineer

 **cā dence**[®]

Grid Matrix: Fidelity Pointwise

DPW-8 / AePW-4 Grid Matrix				Grid Density (Cell Count – Unstr.)						Grid Scale		
WG	Configuration	WingLoading	Rey#	L1	L2	L3	L4	L5	L6	Full	Model	Units
All	ONERA OAT15A (V1)	N/A	3M	43K	88K	154K	248K	382K	575K	X	-	mm
Sctr	ONERA OAT15A (V2)	N/A	3M	132K	235K	380K	584K	880K	1.3M	X	-	mm
Sctr	DPW-3: W1	Jig	5M	7M	22M	45M	99M	169M	279M	X	-	inch
Sctr	DPW-3: W2	Jig	5M	7M	22M	44M	96M	163M	266M	X	-	inch
Sctr/Def	Wing/Body	Jig	5M	18M	44M	92M	168M	318M	564M	X	2.70%	inch
Sctr/Def	Wing/Body	2.50	5M	20M	49M	93M	177M	339M	596M	X	-	inch
Sctr	Wing/Body	2.75	5M			93M				X	-	inch
Sctr	Wing/Body	3.00	5M	18M	44M	93M	170M	324M	577M	X	-	inch
Sctr	Wing/Body	3.25	5M			93M				X	-	inch
Sctr	Wing/Body	3.50	5M			93M				X	-	inch
Sctr	Wing/Body	3.75	5M			93M				X	-	inch
Sctr	Wing/Body	4.00	5M			93M				X	-	inch
Sctr	Wing/Body	4.25	5M			93M				X	-	inch
Def	Wing/Body/Nacelle/Pylon	Jig	5M	20M	50M	105M	192M	366M	650M	X	2.70%	inch
Bft	Wing/Body/Tail (JAXA)	1.22	5M	29M	72M	141M	234M	453M	778M	X	2.16%	mm
Bft	Wing/Body/Tail (JAXA)	2.29	5M	29M	72M	141M	234M	453M	778M	X	2.16%	mm
Bft	Wing/Body/Tail (JAXA)	4.84	5M	29M	73M	143M	252M	458M	786M	X	2.16%	mm
Bft	Wing/Body/Tail (JAXA)	5.89	5M	34M	77M	151M	254M	450M	819M	X	2.16%	mm
Bft	Wing/Body/Tail	Jig	5M	22M	52M	111M	203M	387M	691M	X	2.16%	mm

Automatic Meshing Workflow: Fidelity Pointwise



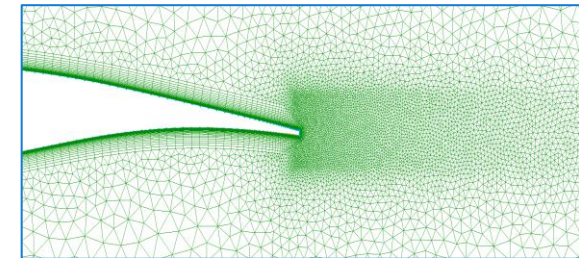
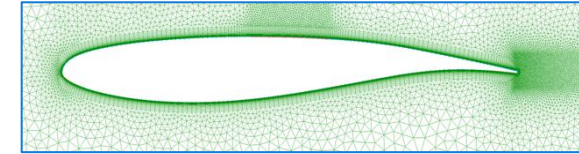
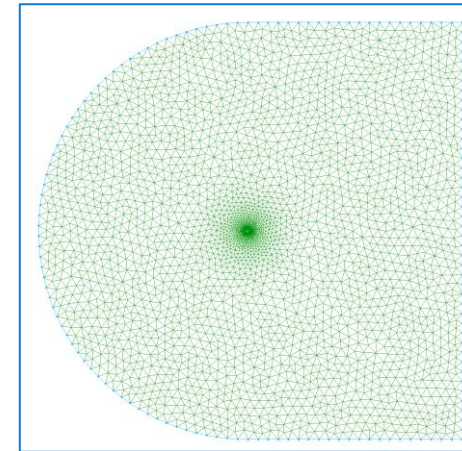
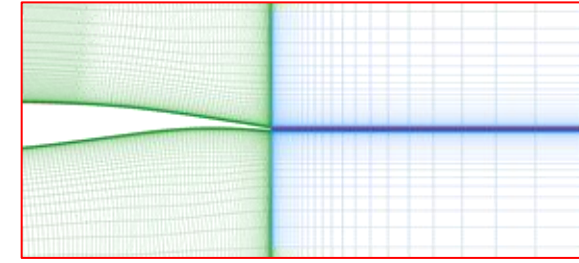
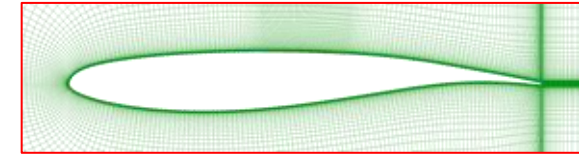
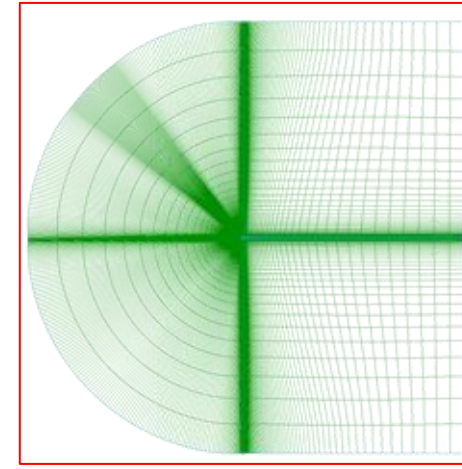
ONERA OAT15A – Grid Guidelines*

Version #1

- Farfield Radius = ~39,000.0mm (100*Semispan, ~170*Chord)
- Grid Topology: Structured[†], Unstructured (Prisms & Hexahedra)
- Growth Rate : $1.16^{\frac{1}{1.5^{(Level-1)}}}$
- Constant Layers on Viscous Wall: 2 (Level 1)
- Wing Spanwise Equilateral Spacing = 1 cell @ 23mm (10% C_{ref})
- Viscous Wall Spacing: $\Delta y = \frac{C_{ref}}{Re_c * \sqrt{\frac{C_f}{2}}}$
 - C_{ref} = 230.0mm
 - Re_c = 3,000,000
 - $C_f = \frac{0.455}{\ln^2(0.06*Re_x)}$
 - Re_x = 0.1*Re_c

[†] Stability, Receptivity, and Sensitivity Analyses of Buffeting Transonic Flow over a Profile, Fulvio Sartor, Clément Mettot, and Denis Sipp AIAA Journal 2015 53:7, 1980-1993

* DPW-8 Gridding Guidelines: https://www.aiaa-dpw.org/ref/gridding_guidelines_v3_07012024.pdf



L	Name	Factor	Growth Rate	Δy (mm)	Y+	#Δy _s
1	Tiny (T)	1	1.16	0.00157	1	2
2	Coarse (C)	0.6667	1.104007	0.00105	0.67	3
3	Medium (M)	0.75	1.068189	0.00079	0.5	4
4	Fine (F)	0.8	1.044958	0.00063	0.4	5
5	Extra Fine (X)	0.8333	1.029752	0.00052	0.33	6
6	Ultra Fine (U)	0.8571	1.019737	0.00045	0.29	7

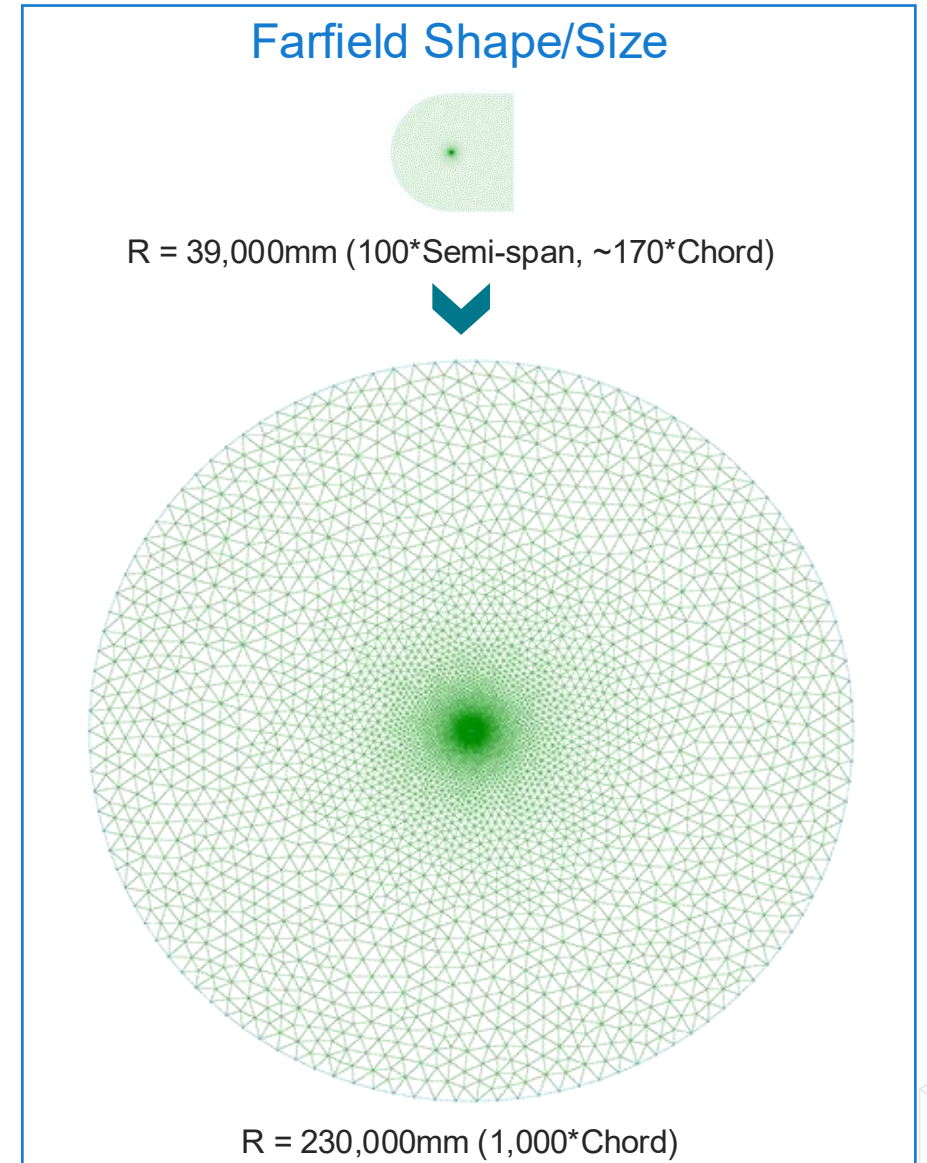
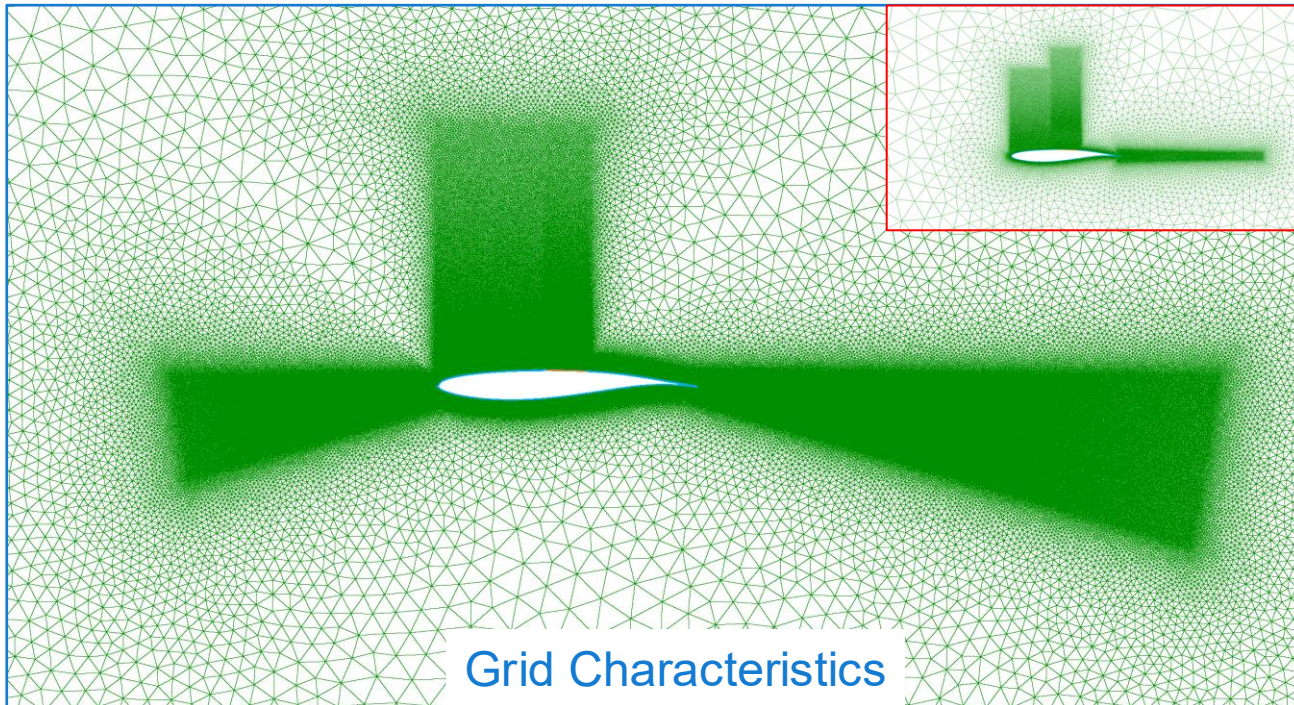
Point Count (Hex, Prism): 57K (L1) – 908K (L6)

Cell Count (Hex, Prism): 43K (L1) – 575K (L6)

ONERA OAT15A

Version #2

- Boundary layer characteristics remain unchanged
- Grid Topology: Unstructured
- Farfield Radius = 230,000.0mm (1000*Chord)
- Updated refined regions to better accommodate AoA sweep



Point Count (Hex, Prism): 168K (L1) – 2.1M (L6)
Cell Count (Hex, Prism): 132K (L1) – 1.3M (L6)

CRM/JAXA – Grid Guidelines*

- Farfield Size = 115,675.0in (100*Semispan)

- Grid Topology: Unstructured, Voxel

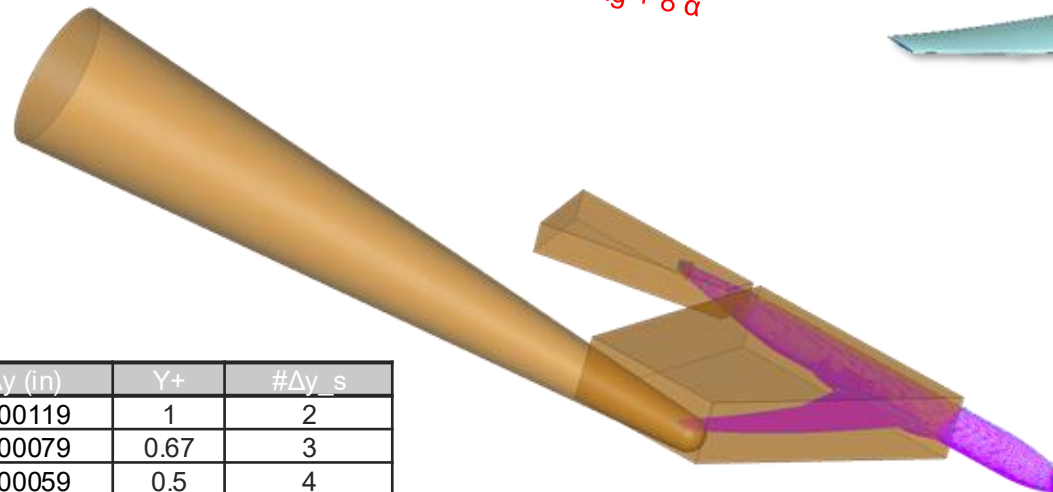
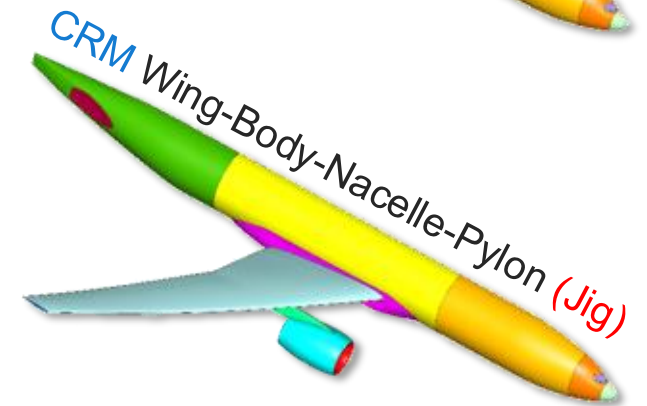
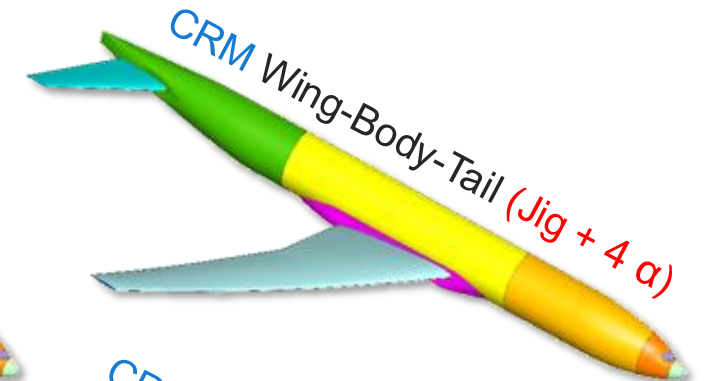
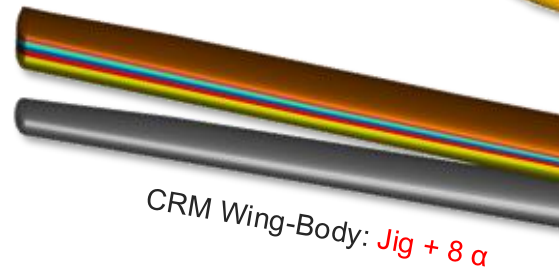
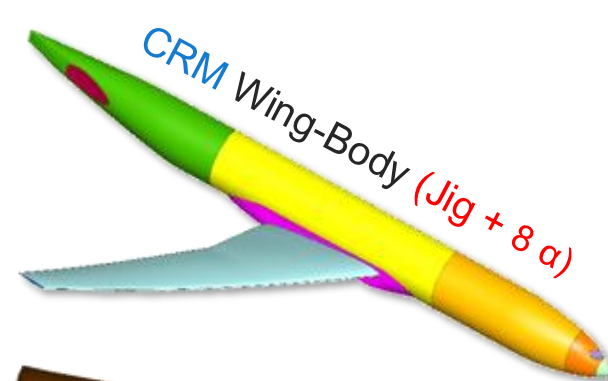
- Growth Rate : $1.16^{\frac{1}{1.5^{(Level-1)}}}$

- Constant Layers on Viscous Wall: 2 (Level 1)

- Viscous Wall Spacing: $\Delta y = \frac{C_{ref}}{Re_c * \sqrt{\frac{C_f}{2}}}$

- $C_{ref} = 275.8in$
- $Re_c = 5,000,000$
- $C_f = \frac{0.455}{\ln^2(0.06*Re_x)}$
- $Re_x = 0.1*Re_c$

L	Name	Factor	Growth Rate	Δy (in)	Y+	# Δy_s
1	Tiny (T)	1	1.16	0.00119	1	2
2	Coarse (C)	0.6667	1.104007	0.00079	0.67	3
3	Medium (M)	0.75	1.068189	0.00059	0.5	4
4	Fine (F)	0.8	1.044958	0.00047	0.4	5
5	Extra Fine (X)	0.8333	1.029752	0.00039	0.33	6
6	Ultra Fine (U)	0.8571	1.019737	0.00034	0.29	7



CRM Wing/Body:

Hex/Voxel

Point Count: 11M (L1) – 493M (L6)

Cell Count: 18M (L1) – 564M (L6)

CRM Wing/Body/Tail:

Hex/Voxel

Point Count: 15M (L1) – 606M (L6)

Cell Count: 25M (L1) – 708M (L6)

CRM Wing/Body/Nacelle/Pylon:

Hex/Voxel

Point Count: 12M (L1) – 567M (L6)

Cell Count: 20M (L1) – 650M (L6)

W1& W2 – Grid Guidelines*

Mesh Families

- 6 Levels:
- Tiny (T), Coarse (C), Medium (M), Fine (F), Extra Fine (X), Ultra Fine (U)

Wall Normal Sizing

- Viscous wall spacing for Grid Level L ($1 \leq L \leq 6$)

- Growth Rate : $1.16^{\frac{1}{1.5^{(Level-1)}}}$

- Constant Layers on Viscous Wall: 2 (Level 1)

- Viscous Wall Spacing: $\Delta y = \frac{C_{ref}}{Re_c * \sqrt{\frac{C_f}{2}}}$

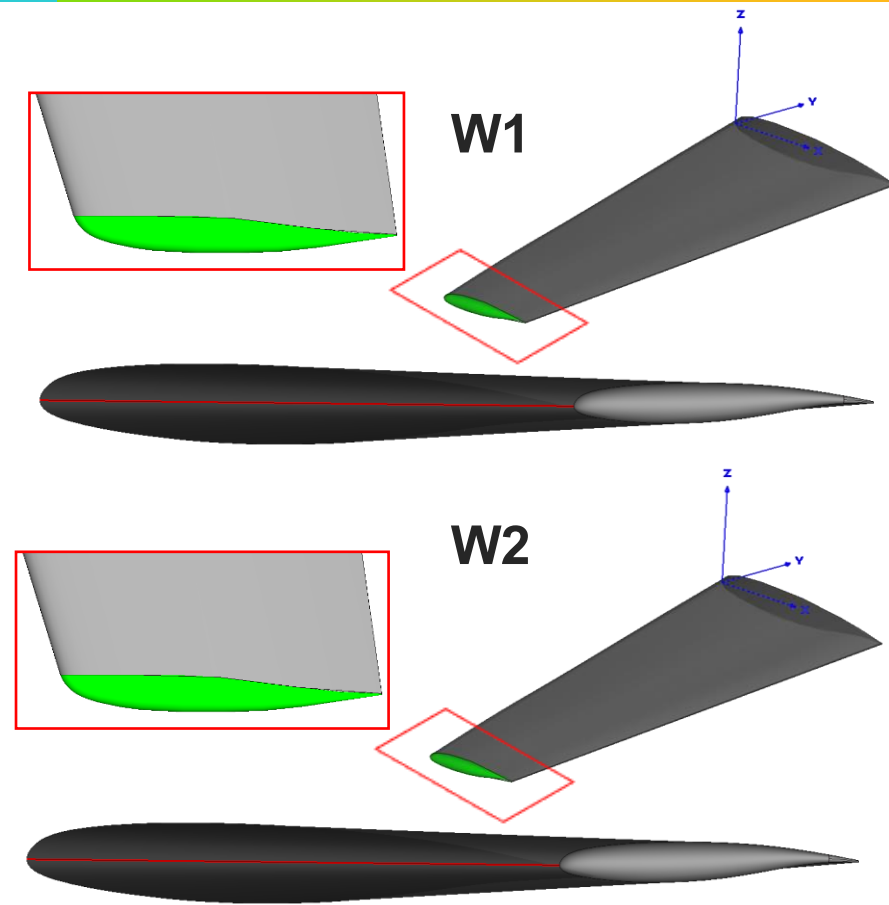
- $C_{ref} = (7.7778\text{in})$

- $Re_c = 5,000,000$

- $C_f = \frac{0.455}{\ln^2(0.06 * Re_x)}$

- $Re_x = 0.1 * Re_c$

* DPW-8 Gridding Guidelines: https://www.aiaa-dpw.org/ref/gridding_guidelines_v3_07012024.pdf



L	Name	Factor	Growth Rate	Δy (in)	Y+	# Δy_s
1	Tiny (T)	1	1.16	0.0000336	1	2
2	Coarse (C)	0.6667	1.104007	0.0000224	0.67	3
3	Medium (M)	0.75	1.068189	0.0000168	0.5	4
4	Fine (F)	0.8	1.044958	0.0000134	0.4	5
5	Extra Fine (X)	0.8333	1.029752	0.0000112	0.33	6
6	Ultra Fine (U)	0.8571	1.019737	0.0000096	0.29	7

W1& W2

Mesh families (Rev. 0)

Hex/Voxel

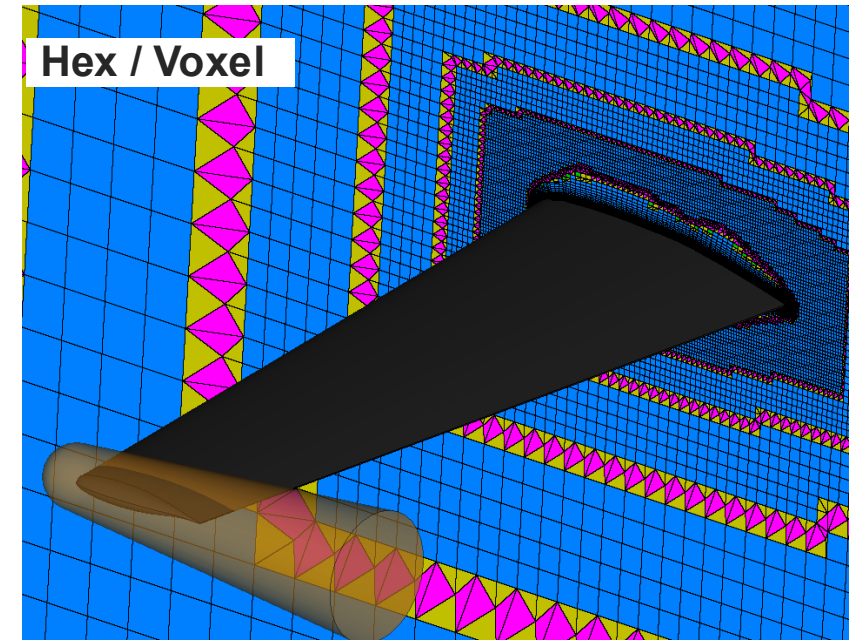
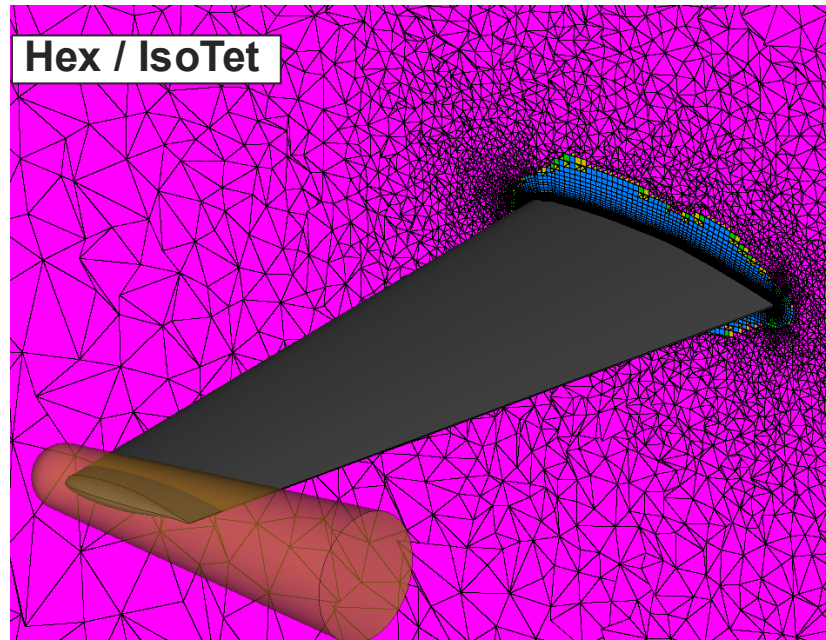
Point Count: 3M (L1) – 170M (L6)

Cell Count: 4M (L1) – 190M (L6)

Hex/IsoTet

Point Count: 3M (L1) – 170M (L6)

Cell Count: 4M (L1) – 190M (L6)



Mesh families (Rev. 1)

Hex/Voxel

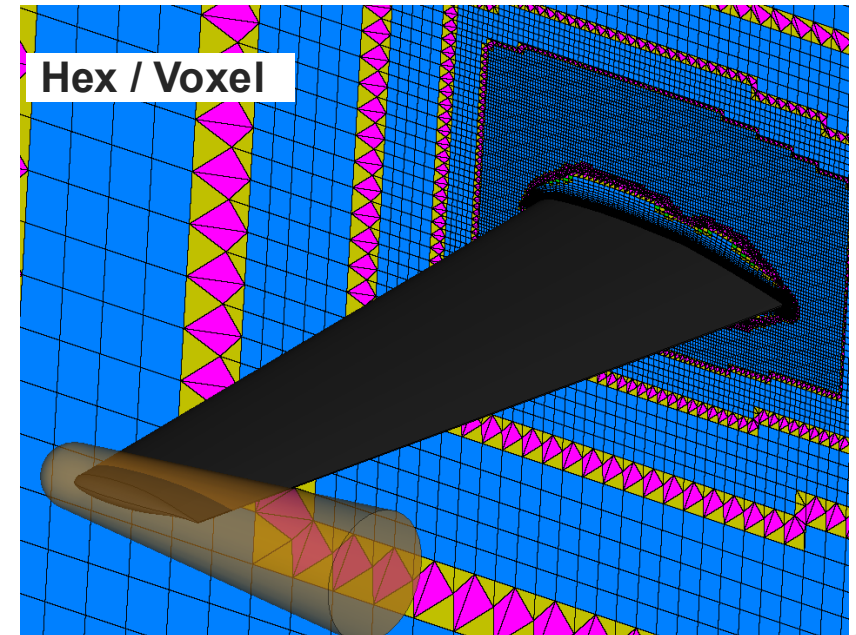
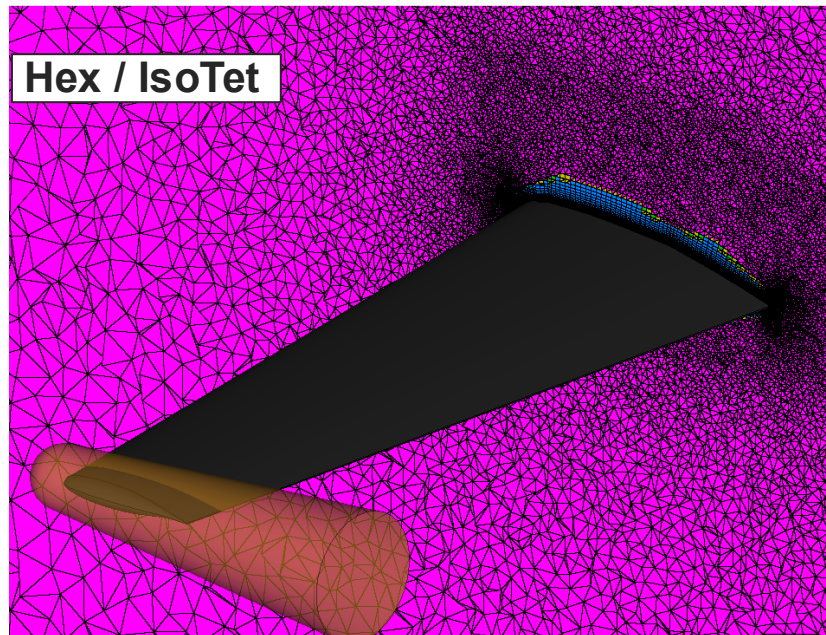
Point Count: 4M (L1) – 250M (L6)

Cell Count: 7M (L1) – 270M (L6)

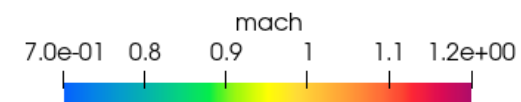
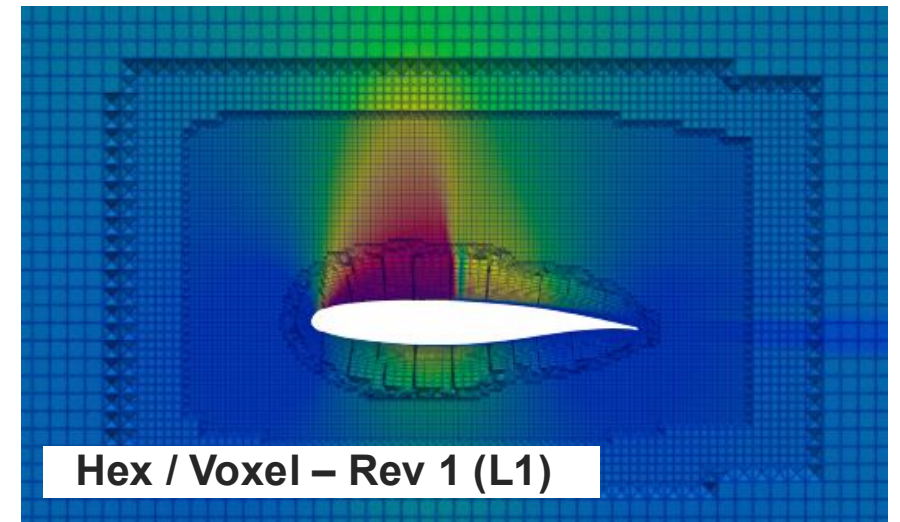
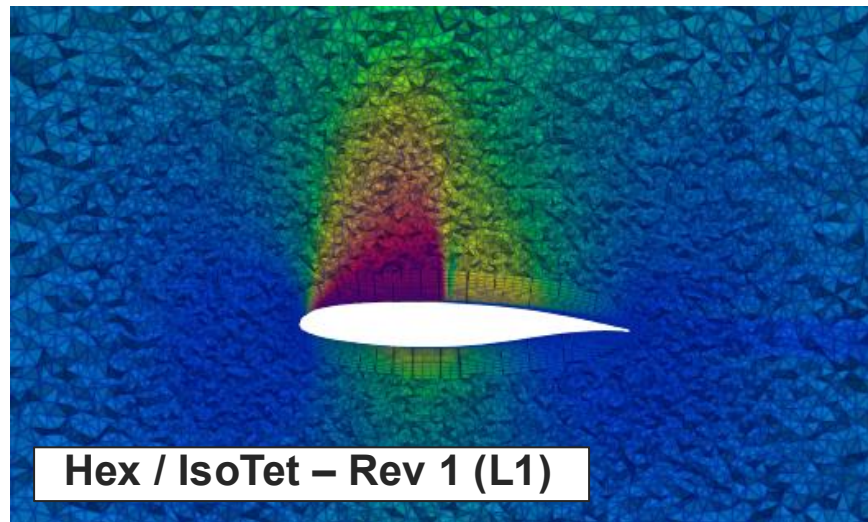
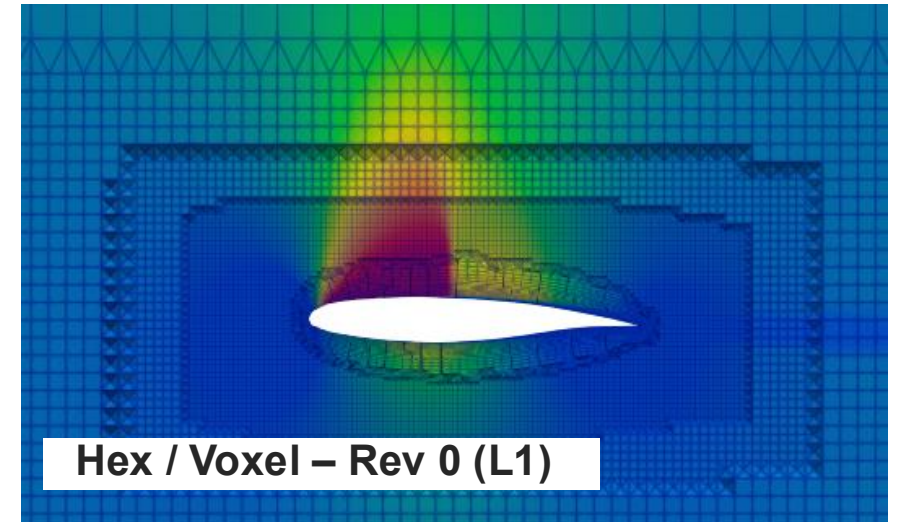
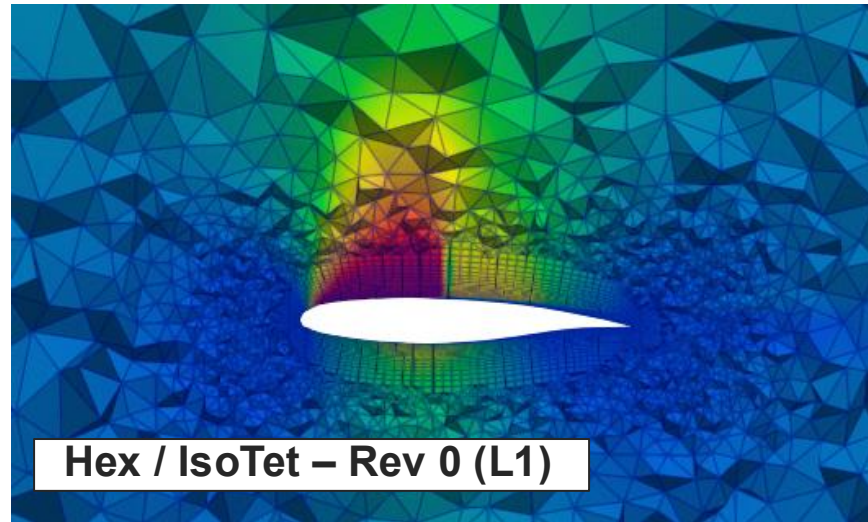
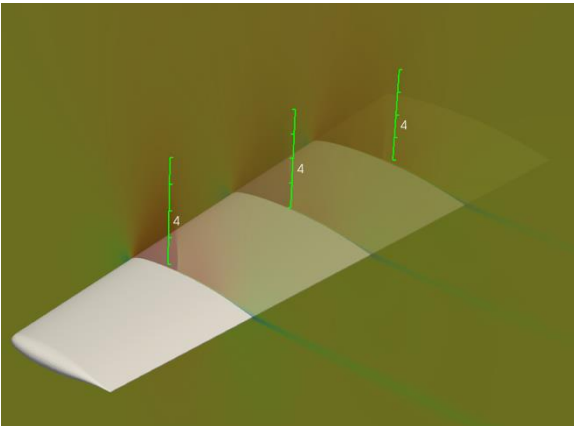
Hex/IsoTet

Point Count: 4M (L1) – 220M (L6)

Cell Count: 12M (L1) – 370M (L6)



Improvement of Fixed Grids (Informed by RANS runs)





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