DPW-8 & AePW-4

Gridding Guidelines

Version 3
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AIAA
SHAPING THE FUTURE OF AEROSPACE

Revision History

Version 1: June 18, 2024

Version 2: June 27, 2024
Fixed typo on (L+2)/(L+1) on Surface Spacing slide
Updated to chord length of 230mm for ONERA OAT15A

Version 3: July 1, 2024
Clarified variable "L" as Grid Level throughout Guidelines; fixed growth rate equation to be [1.5^(L-1)]

Gridding Guidelines – Wall Normal Sizing

- **Consistent with DPW-7** (https://aiaa-dpw.larc.nasa.gov/Workshop7/DPW-VII_BaselineGridFamilyPlanRevB.pdf)
- **Viscous wall spacing for Grid Level L (1 ≤ L ≤ 6, see next slide)**

$$Re_x = 0.1Re_c$$

$$C_f = \frac{0.455}{[ln(0.06Re_x)]^2}$$

$$\Delta y_1 = \frac{c_{ref}}{Re_c\sqrt{C_f/2}}$$

$$\frac{\Delta y_L}{\Delta y_{L-1}} = 1.16^{\frac{1}{1.5^{(L-1)}}}$$

- **At Least two constantly-spaced cells at viscous walls**
- **See "#Δy_1s" on "Baseline Grid Family Plan" slide**
- **Growth Rates < 1.2x normal to viscous walls**

Viscous growth levels are consistent with
Pita, Claudio M. and Woeber, Carolyn. "HLPW4/GMGW3: Summary of Unstructured Fixed Mesh Generation Efforts for RANS Analysis." AIAA 2022-3209.

Baseline RANS Grid Family Plan: Re_c = 5 million

- Re_c = 5 million
- CRM, full scale in inches (c_{ref} = 275.8 inches)
- Scale linearly for ONERA OAT15A

Name	Grid Level (L)	Δy_1 (inches)	Factor	y^+	#Δy_1s	Viscous Growth Rate
Tiny (T)	1	0.0011922	1.0000	~1.00	2	1.160000
Coarse (C)	2	0.0007950	0.6668	~0.67	3	1.104007
Medium (M)	3	0.0005961	0.7498	~0.50	4	1.068189
Fine (F)	4	0.0004770	0.8002	~0.40	5	1.044958
Extra Fine (X)	5	0.0003972	0.8328	~0.33	6	1.029752
Ultra Fine (U)	6	0.0003405	0.8571	~0.29	7	1.019737

Baseline RANS Grid Family Plan: Re_c = 30 million

- Re_c = 30 million
- CRM, full scale in inches (c_{ref} = 275.8 inches)
- Scale linearly for ONERA OAT15A

Name	Grid Level (L)	Δy_1 (inches)	Factor	y^+	#Δy_1s	Viscous Growth Rate
Tiny (T)	1	0.0002332	1.0000	~1.00	2	1.160000
Coarse (C)	2	0.0001555	0.6668	~0.67	3	1.104007
Medium (M)	3	0.0001166	0.7498	~0.50	4	1.068189
Fine (F)	4	0.0000933	0.8002	~0.40	5	1.044958
Extra Fine (X)	5	0.0000777	0.8328	~0.33	6	1.029752
Ultra Fine (U)	6	0.0000666	0.8571	~0.29	7	1.019737

Surface Spacing (ONERA OAT15A)

- **Only applicable if computations are being performed with a finite span**
- **Full-span airfoil spanwise spacing recommendation**
  - Desire approximately $C_{ref}/112.5$
  - If using full-scale geometry (230mm chord) spanwise cell size would be ~2.04mm
- **Wing TE Base >> 8 Cells**
- **Grid growth**
  - Grow next-finer grid in family by approximately $[(L+2)/(L+1)]^3$ in size
  - Scale dimensions in all three dimensions by approximately $[(L+2)/(L+1)]$
  - Grid spacing factors seen on "Baseline RANS Grid Family Plan"
- **Farfield boundary > 100 chord lengths**

Surface Spacing (CRM)

- **Wing spanwise spacing < 0.1%*semispan at root & tip**
- **Wing chordwise spacing < 0.1%*c (local chord) at LE & TE**
- **Wing TE base >> 8 Cells**
- **Spacing near fuselage nose & end of body < 1%*C_{ref}**
- **Grid growth**
  - Grow next-finer grid in family by approximately $[(L+2)/(L+1)]^3$ in size
  - Scale dimensions in all three dimensions by approximately $[(L+2)/(L+1)]$
  - Grid spacing factors seen on "Baseline RANS Grid Family Plan"
- **Farfield boundary > 100 semispan lengths (1156.75 inches)**

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