High Lift Prediction Workshop 4 Fixed RANS Structured Overset Mesh Summary

Mesh Generation and Testing by Members of the Launch Ascent and Vehicle Aerodynamics (LAVA) Team:

Luis dos Santos Fernandes, Leonardo Machado, Elisha Makarevich, Jeffrey A. Housman, Jared C. Duensing, and Cetin C. Kiris

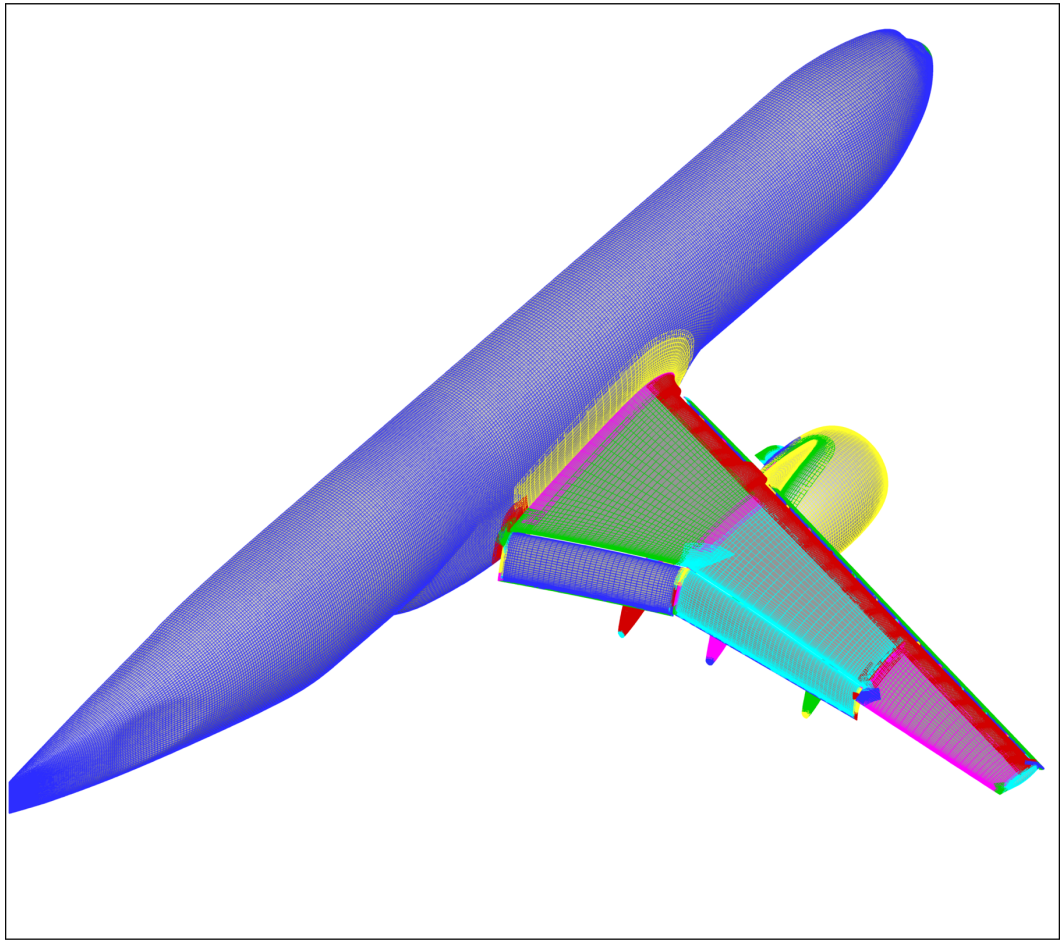
Computational Aerosciences Branch, NASA Ames Research Center

01/11/2021

POC: Cetin C. Kiris

Mesh Refinement Study Efforts

- Structured overset grid levels A-D generated by the Launch Ascent and Vehicle Aerodynamics (LAVA) team for the HLPW4 CRM geometry
- HLPW4 CRM full-scale geometry steady RANS simulations completed using LAVA Curvilinear to test meshes (Condition (Case 1a): M_∞= 0.2, Re_c = 5.49 M, α = 7.01°, T_{ref} = 289.4 K, Nominal flaps (40°/37°))
- Numerical scheme and turbulence model used to run test simulations
  - 3rd order convective flux discretization (modified Roe scheme) with Koren limiter
  - Spalart Allmaras (SA-RC-QCR2000)

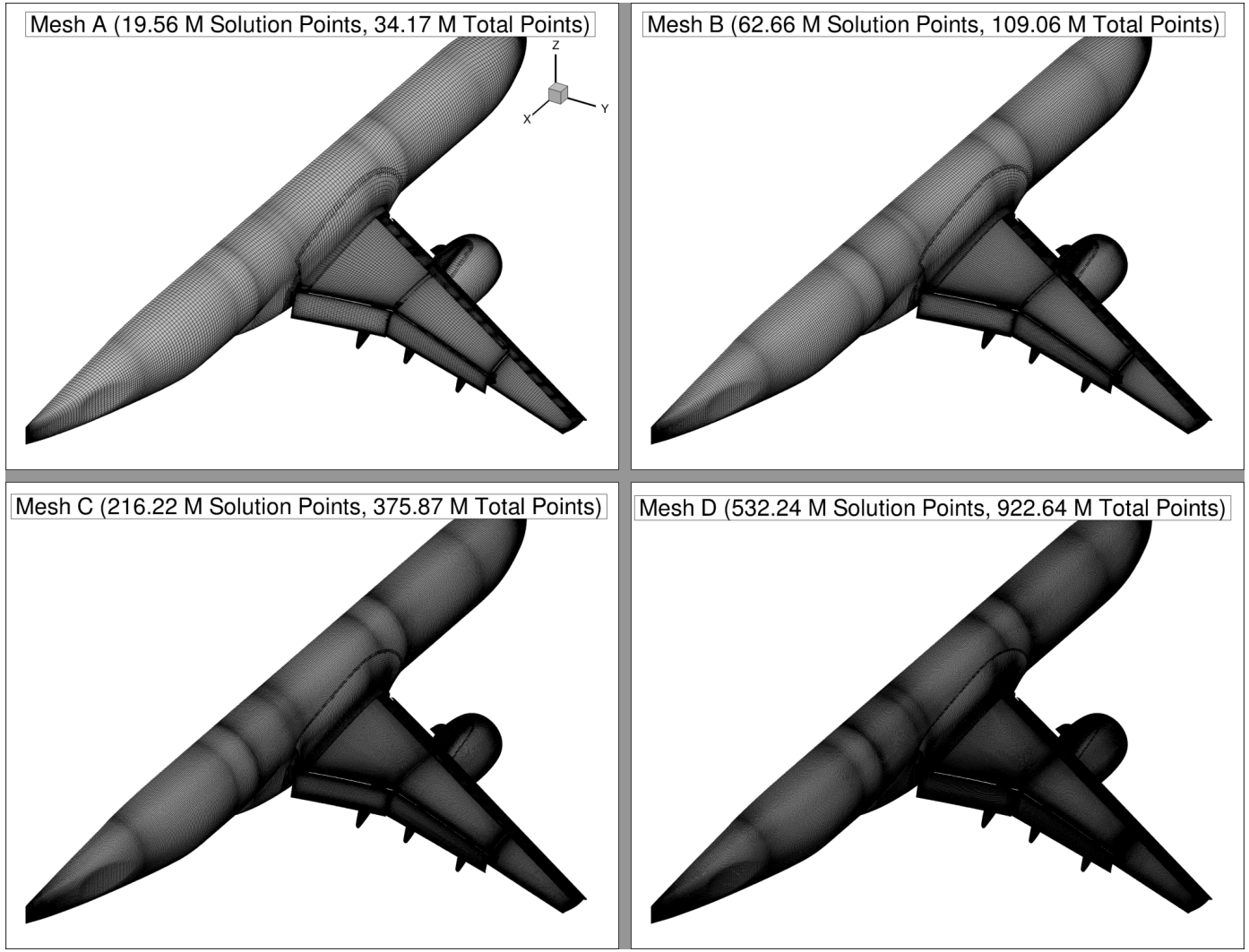


Structured Overset Mesh Overview

- Mesh statistics provided for mesh levels A-D as requested by the GMGW
- Surface meshes shown with blanking on right

Grid metrics and statistics

Metric	Mesh A	Mesh B	Mesh C	Mesh D
Total Solution Nodes*	19.56 M	62.66 M	216.22 M	532.24 M
Total Nodes	34.17 M	109.06 M	375.87 M	922.64 M
Surface Mesh				
Area Ratio (avg.)	1.1948	1.1288	1.0857	1.0655
Area Ratio (max.)	8.7107	8.6774	11.935	17.656
Aspect Ratio (avg.)	11.231	11.016	10.881	11.066
Aspect Ratio (max.)	539.89	624.67	604.03	598.9
Volume Mesh				
Wall normal length ratio (avg.)	1.1976	1.1337	1.0873	1.0628



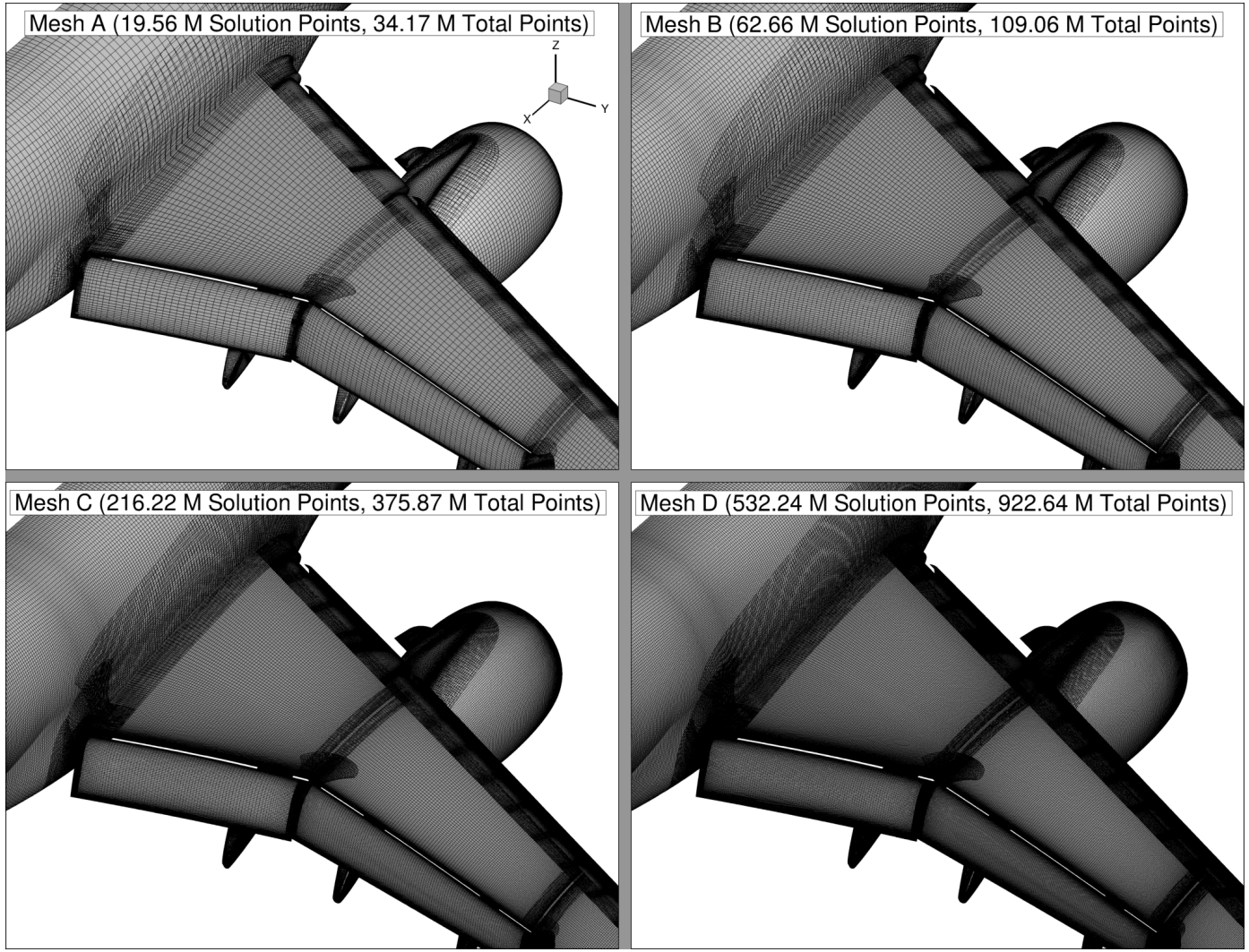
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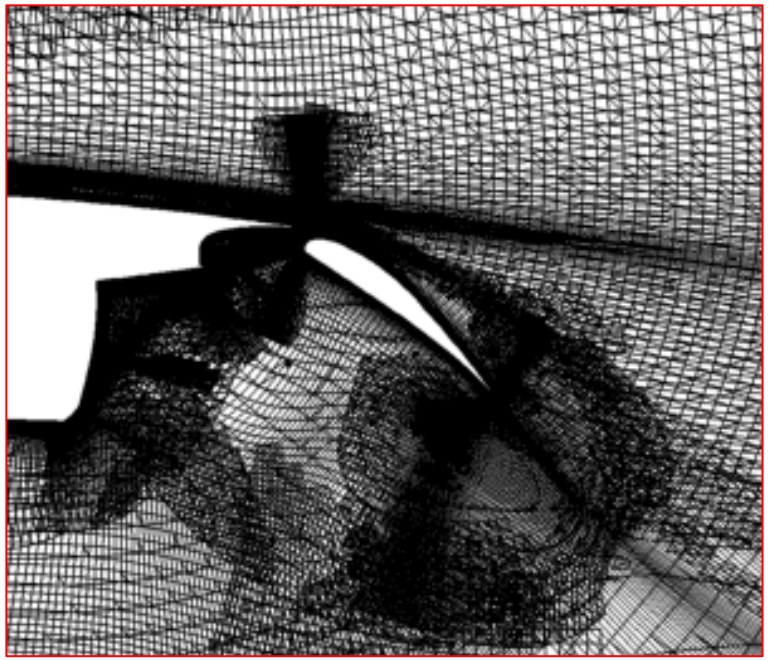
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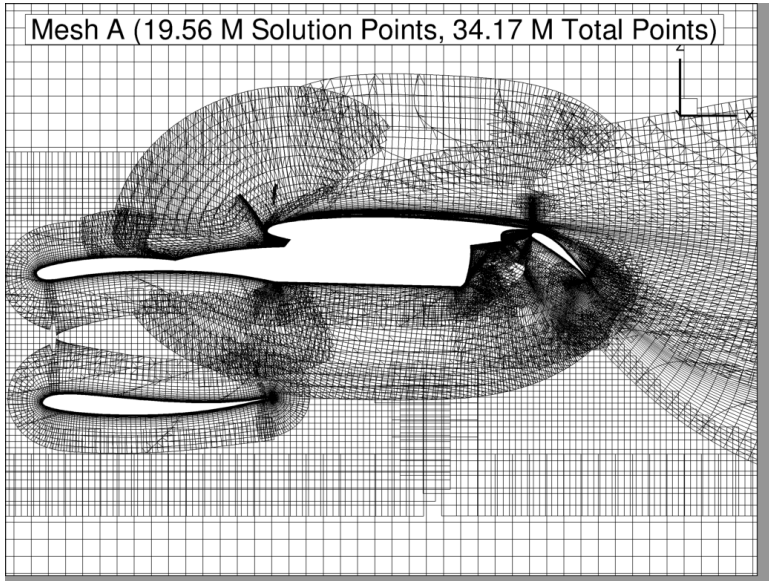


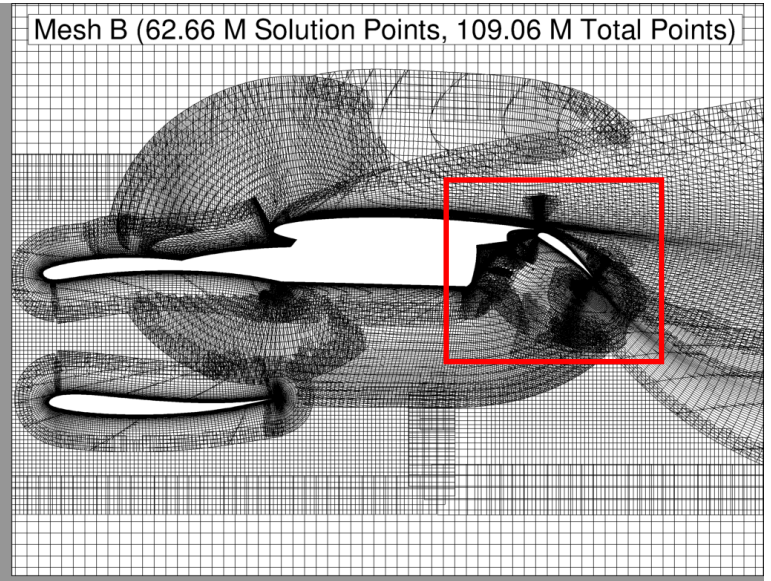
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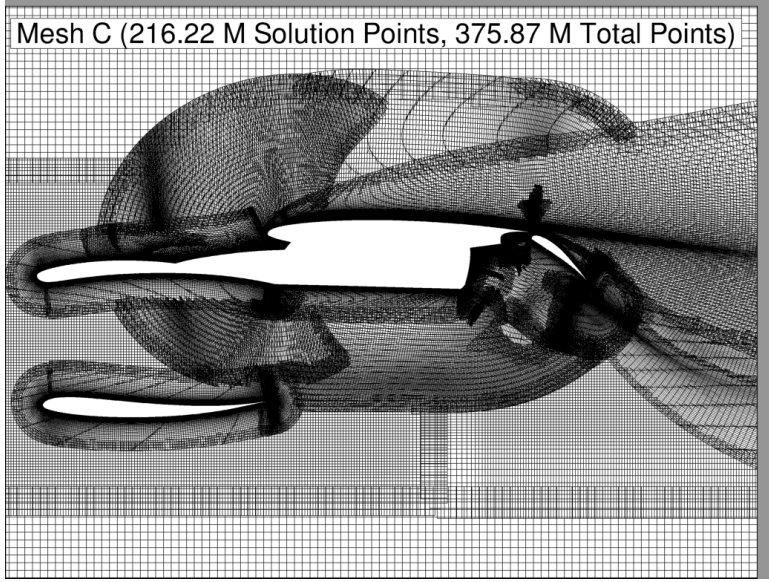
Mesh Structured Overset Mesh Overview

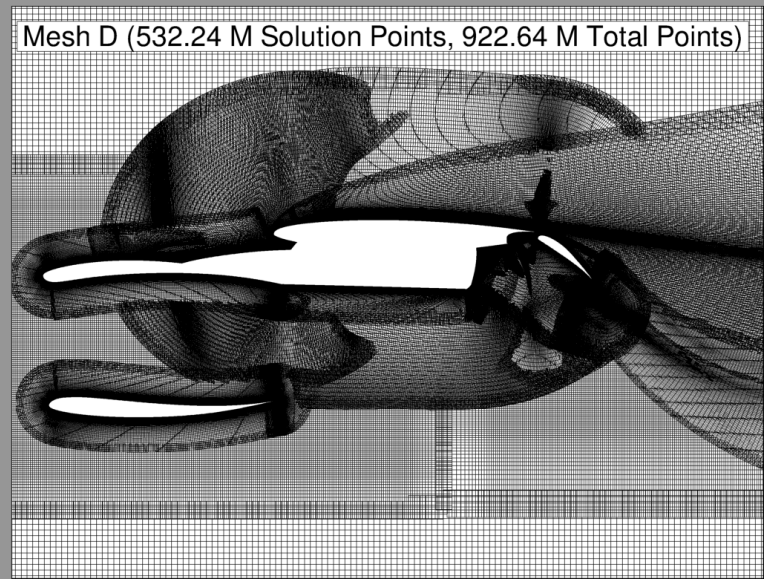
- Mesh slice at y = 9.7 m for levels A-D





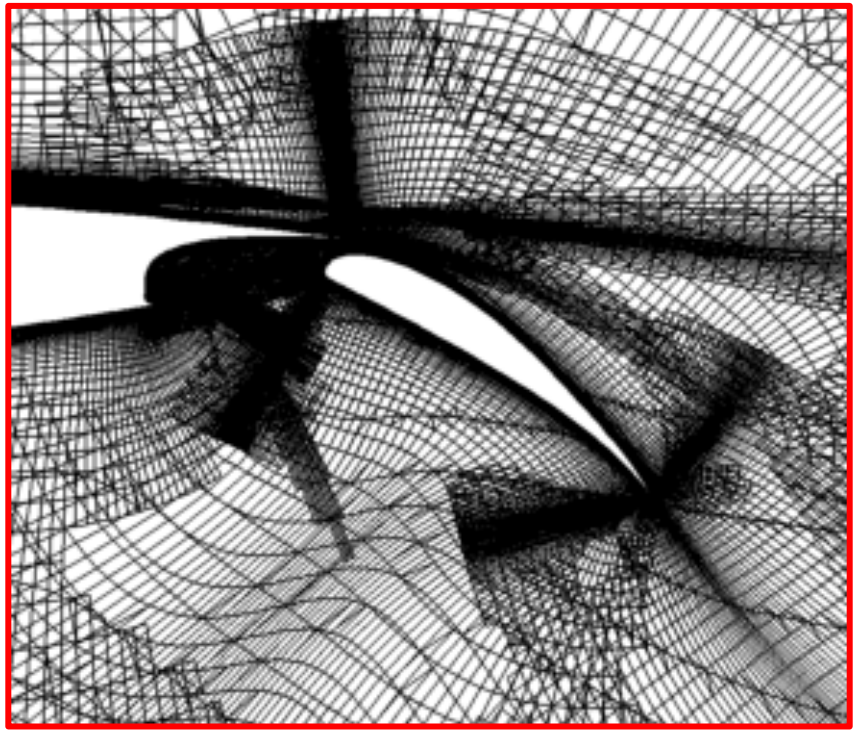


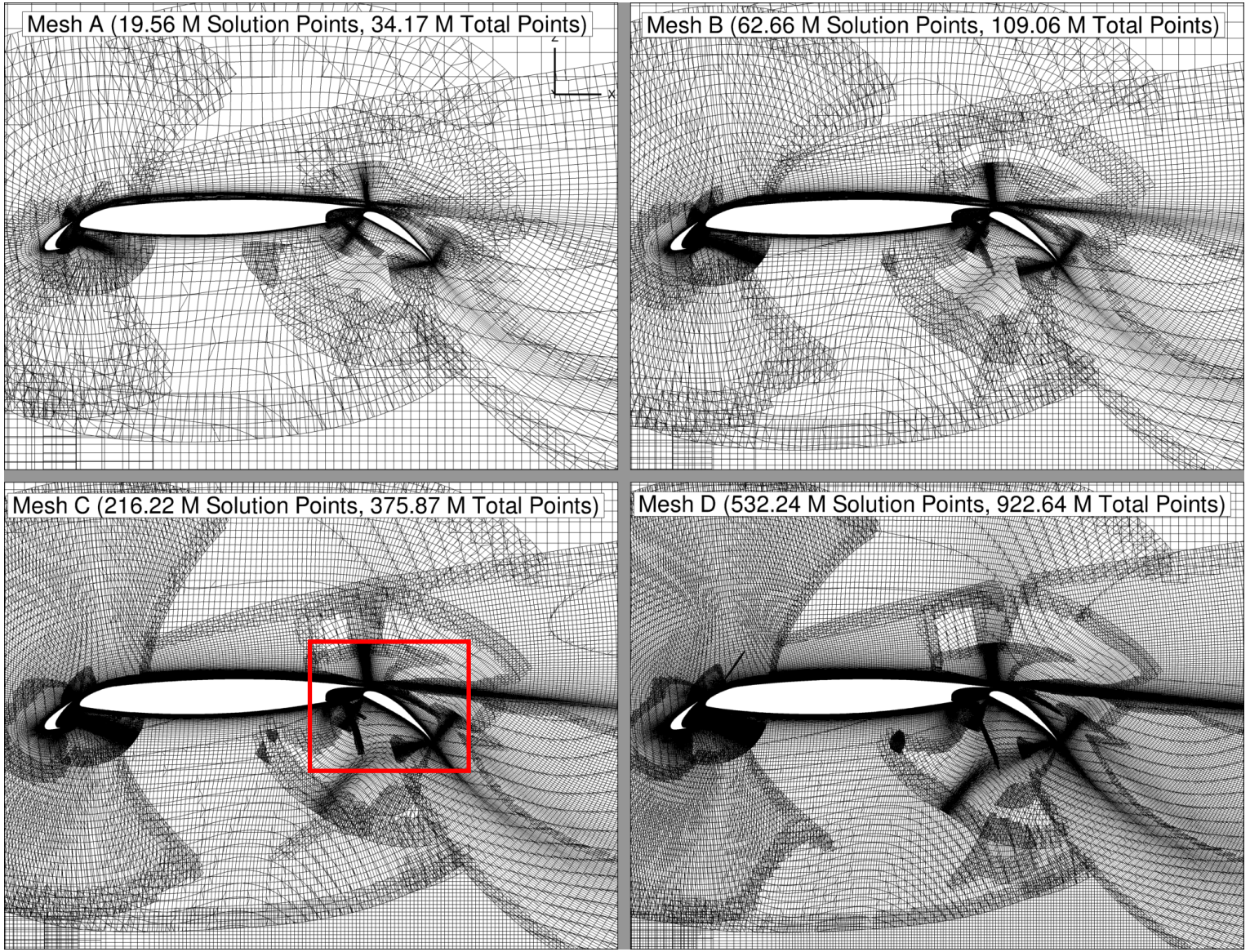




Structured Overset Mesh Overview

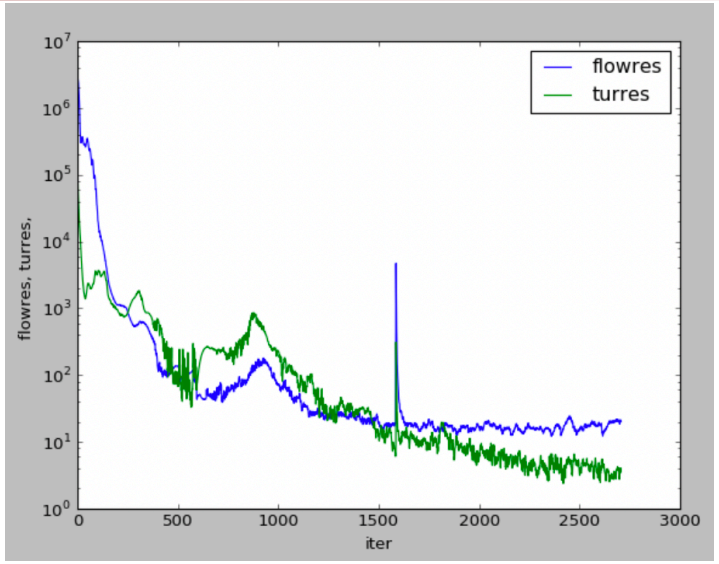
- Mesh slice at y = 20.1 m for levels A-D



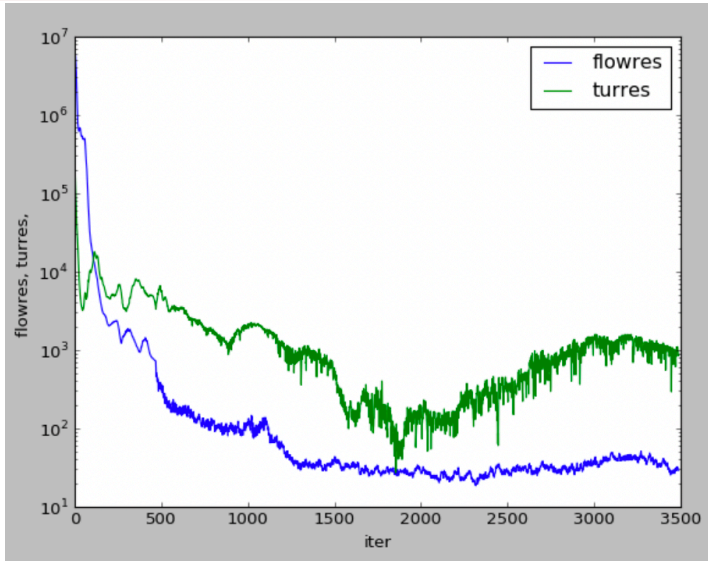


Convergence Histories/Integrated Loads

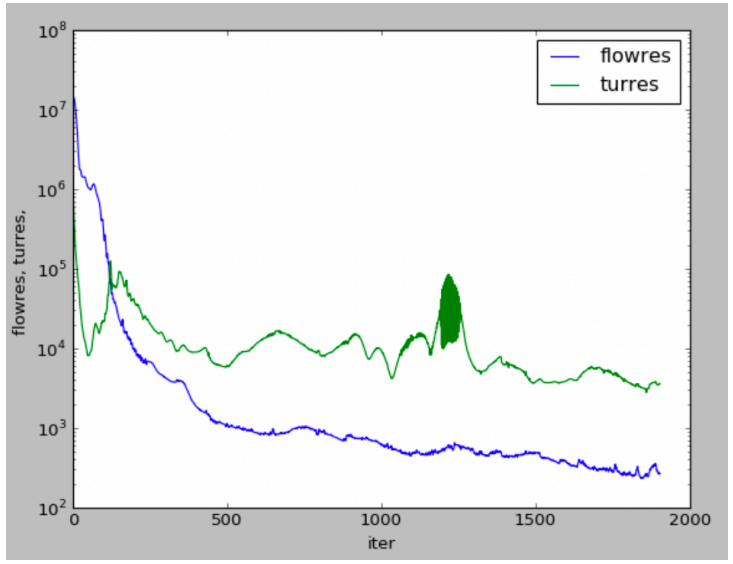
- Residual plots for the mean flow equations (blue) and turbulence equation (green) shown for the family of meshes
- Cases were run until at least until convergence criteria was met
  - Standard deviation of drag coefficient below 1/10 of a drag count (1e-5)
  - Measured over final 100 nonlinear iterations



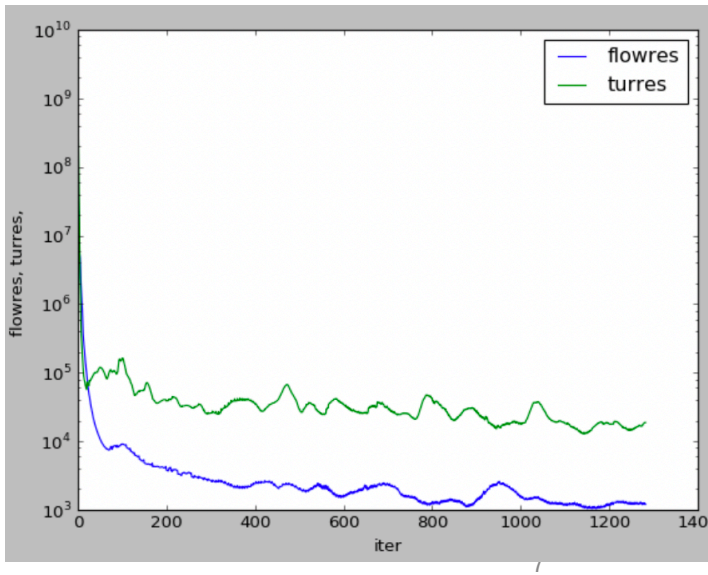
Mesh A



Mesh B



Mesh C



Mesh D