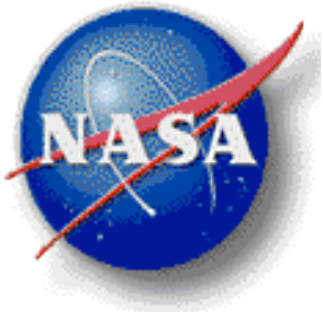

FUN3D Analysis of DPW-III Wing/Body Configurations

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3rd AIAA CFD Drag Prediction Workshop
Sponsored by the Applied Aerodynamics TC
San Francisco, California, June 3-4, 2006

FUN3D Unstructured Grid Code

- Parallel 3D compressible finite-volume RANS for tetrahedral meshes
- Implicit time-stepping using point Gauss-Seidel and line-relaxation for linear system
- Upwind Roe scheme for inviscid fluxes
- Galerkin-type approximation for viscous fluxes
- Full Navier-Stokes equations
- Spalart-Allmaras & SST turbulence models (loosely coupled)

FUN3D Unstructured Grid Code

- Parallel version
  - Pre-processor, flow solver and post-processor fully parallel
  - Domain decomposition using the MeTiS and ParMetis mesh partitioning software (weighted for the line solver)
  - Parallel code execution scheme utilizes MPI

Computational Grids – Wing/Body

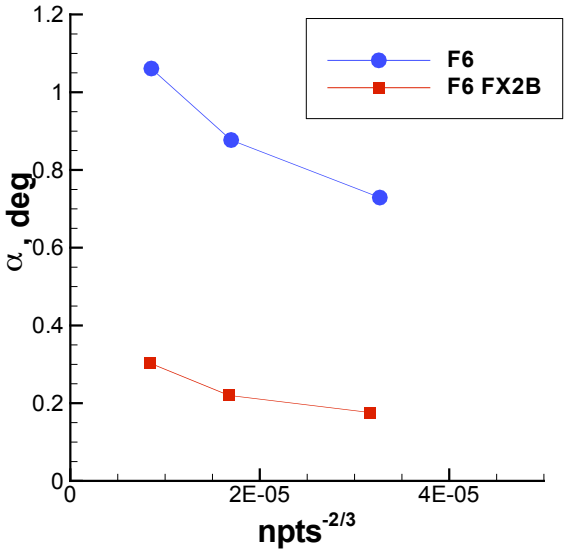
- Workshop VGRIDns node-based grids (with the octree based spacing of Kania)
- VGRIDns 64-bit batch on columbia (Pirzadeh)

	Wing/Body Total Nodes	Wing/Body/Fairing Total Nodes
Coarse	5,354,214	5,618,073
Medium	14,298,135	14,598,610
Fine	40,014,934	41,069,036

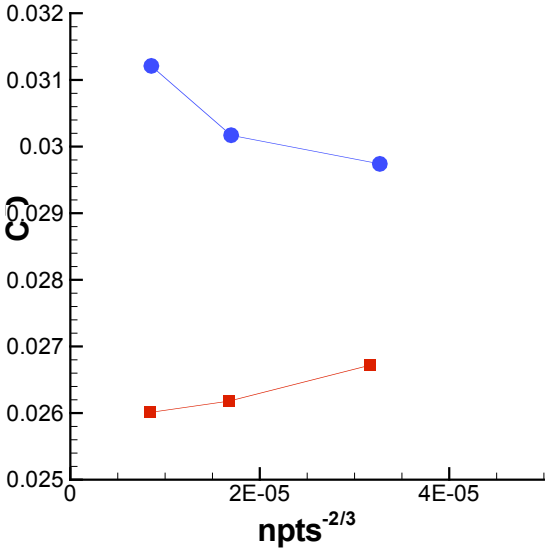
Summary FUN3D Results

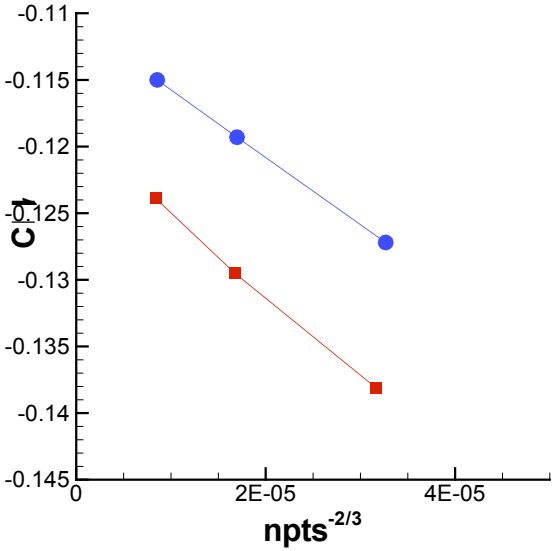
- Case 1A: Mach 0.75, C_L=0.5, Re_c=5x10^6 (SA fully turbulent)
  - Wing/body coarse, medium, and fine grids
  - Wing/body/fairing coarse, medium, and fine grids
- Case 1B: Mach 0.75, C_L=0.5, Re_c=5x10^6 (SA fully turbulent)
  - Wing /body medium grid polar
  - Wing/body/fairing medium grid polar

Wing/Body Grid Refinement

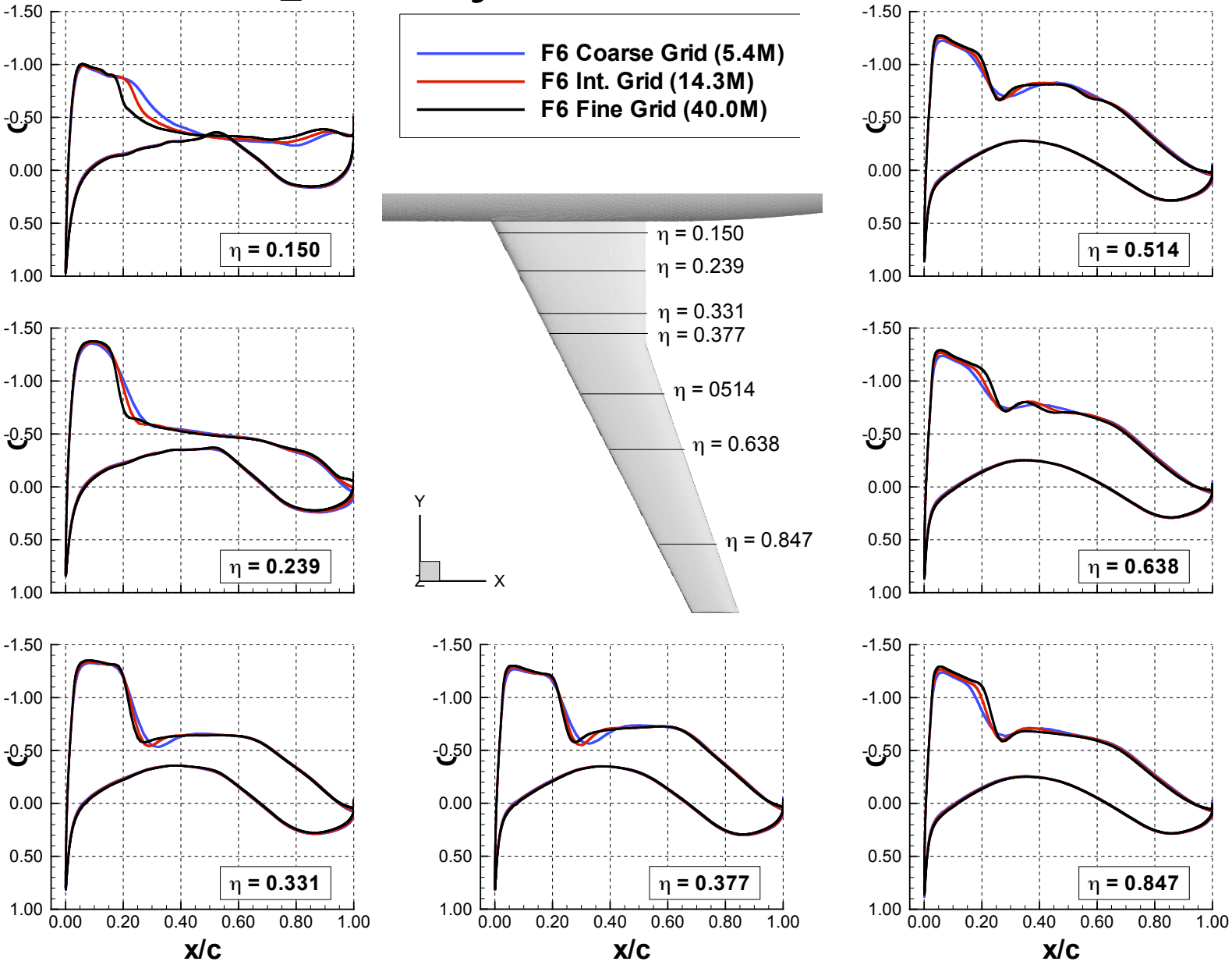


Mach 0.75
C_L=0.5
Re_c=5x10^6
Spalart-Allmaras
Fully Turbulent

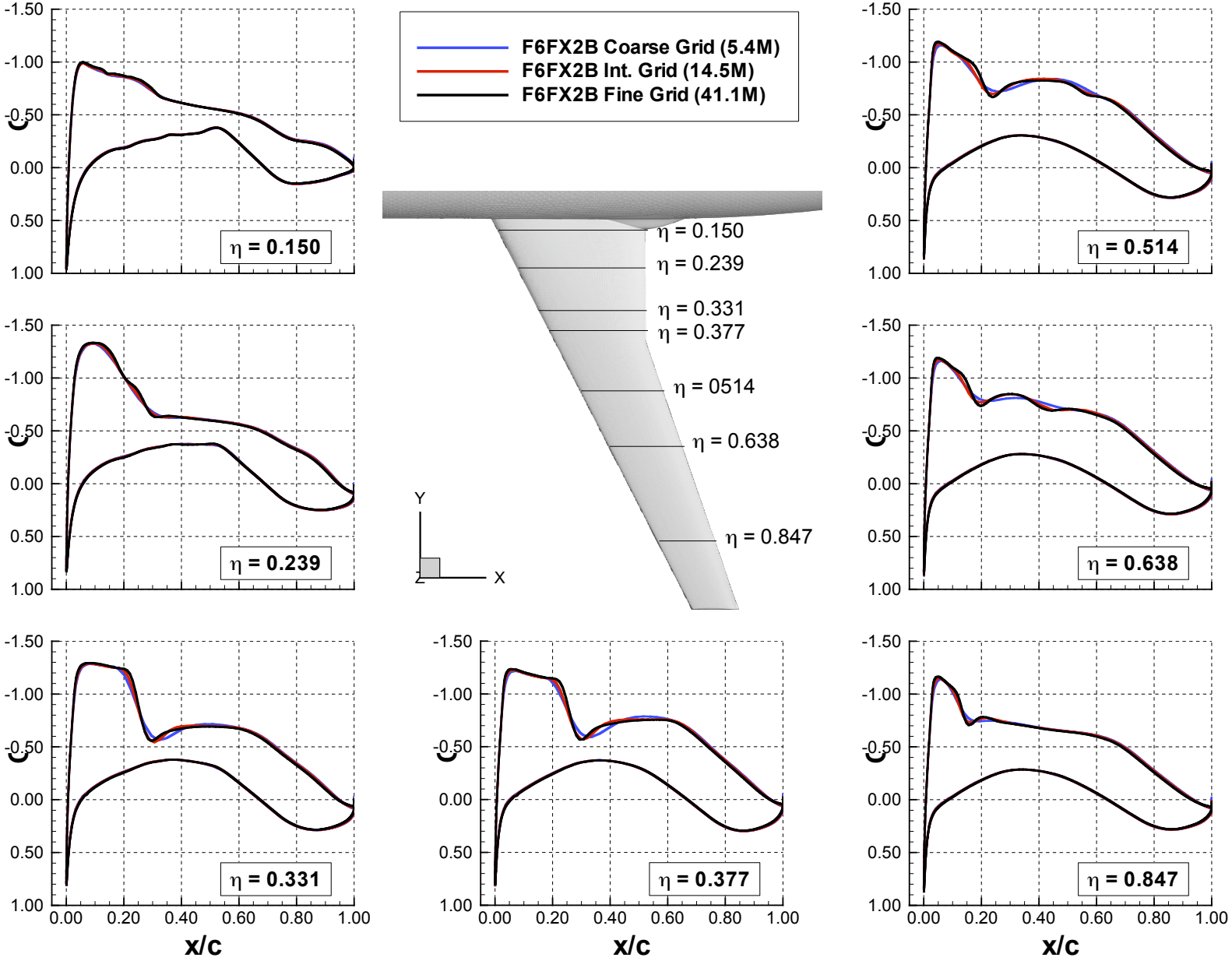




Wing/Body Grid Refinement

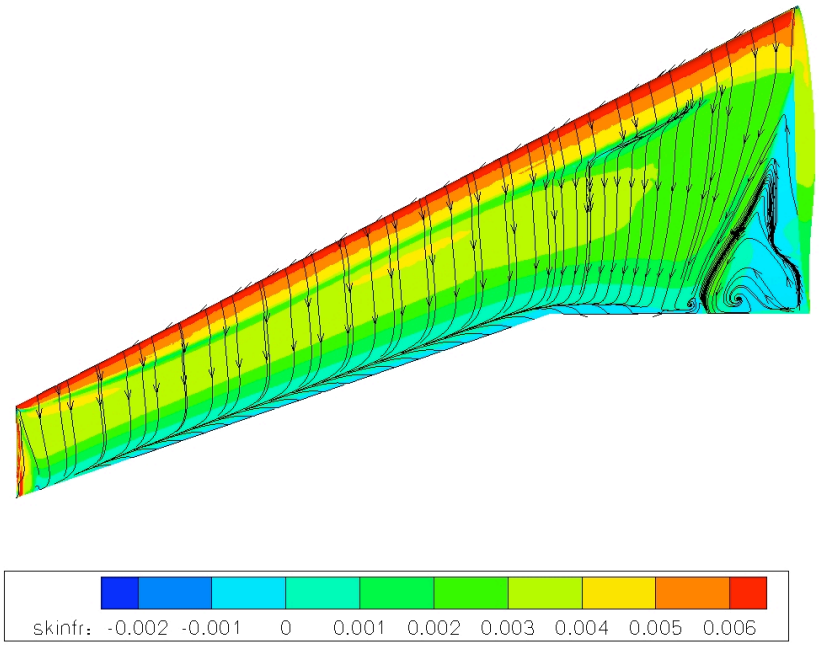


Wing/Body/Fairing Grid Refinement

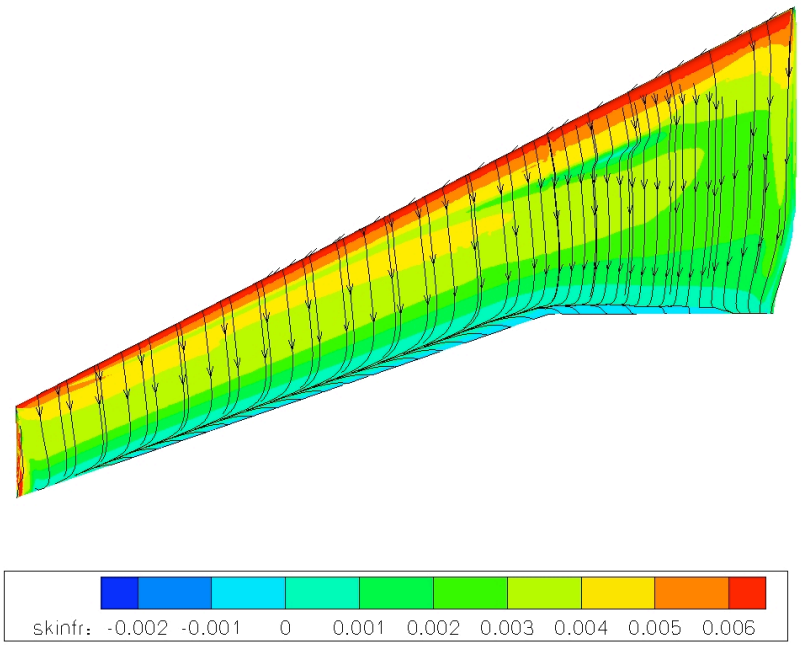


Wing/Body Fine Grid
Streamlines & Skin Friction

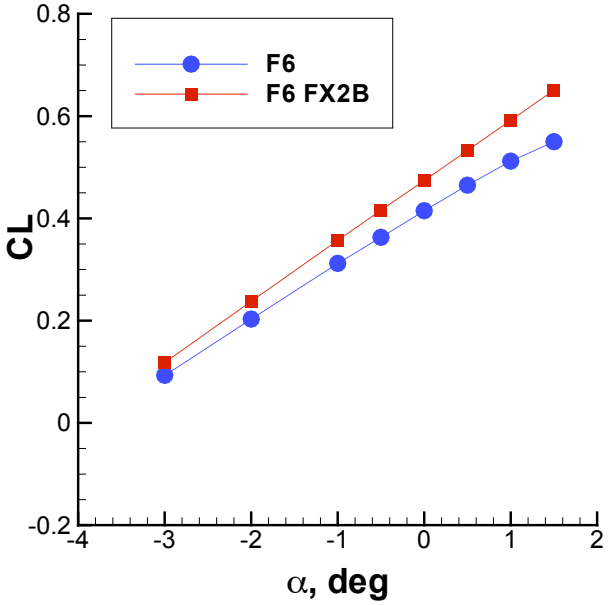
F6



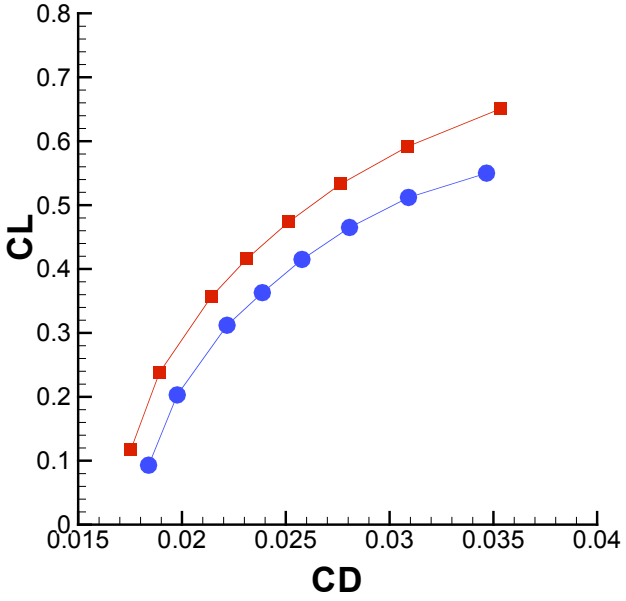
F6FX2B

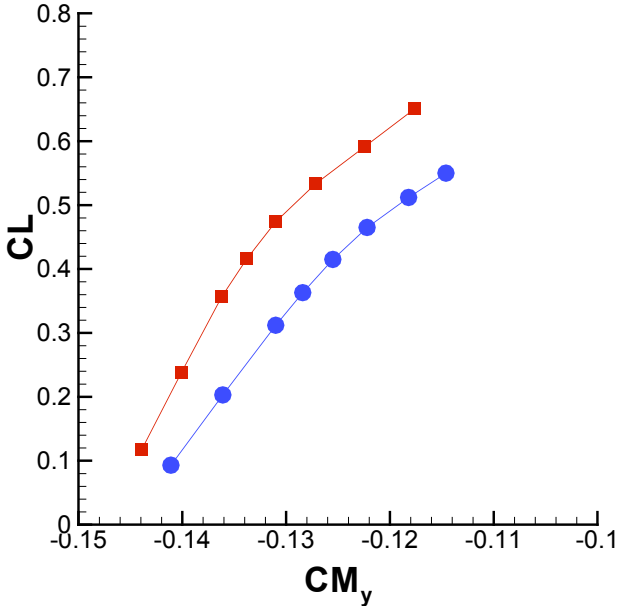


Wing/Body Polar



Mach 0.75
$Re_c=5x10^6$
Spalart-Allmaras
Fully Turbulent





Summary

- Case 1A- F6
  - Drag is increasing with grid refinement
  - Significant wing/root juncture separation
  - Trailing edge separation
- Case 1A-F6FX2B
  - Drag is decreasing with grid refinement
  - No wing/root juncture separation
  - Trailing edge separation
- Case 1B
  - Improved performance with fairing over range of angles of attack