

FUN3D Results for HiLift-PW 2

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(HILIFTPW-2)
San Diego, CA
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Outline

- Grids
- Solver
- Case 1
- Conclusions

Grids

- Grid set D_uns_mix_Case1Config2_v2
 - Generated by Univ. of Wyoming and Cessna
 - Fully tet grid grown with VGrid then viscous cells merged into prisms
- Sizes:
 - Coarse: 10.2 M nodes (15.4 M prisms/13.8 M tets)
 - Medium: 30.8 M nodes (40.9 M prisms/58.3 M tets)
 - Fine: 75.9 M nodes (86.7 M prisms/187 M tets)
 - Mistakenly used initial viscous spacing value from Medium grid.
 - Extra Fine grid not possible to be grown
- Not possible to strictly adhere to gridding guidelines and still be able to achieve a family of grids.
- Requirement of grid family meant significant deviations from “best practices” had to be made.
- Would suggest future workshops include actual “best practice” grid that represents type of grids used in real world.

Solver

FUN3D from NASA Langley

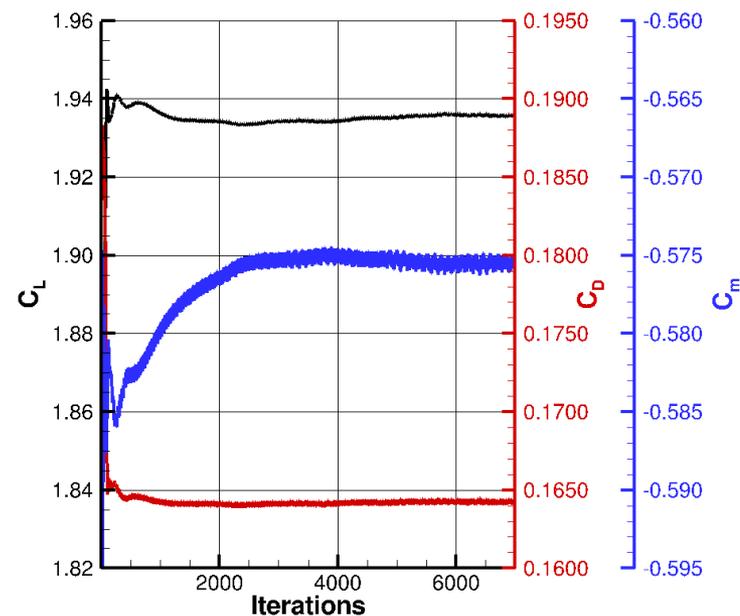
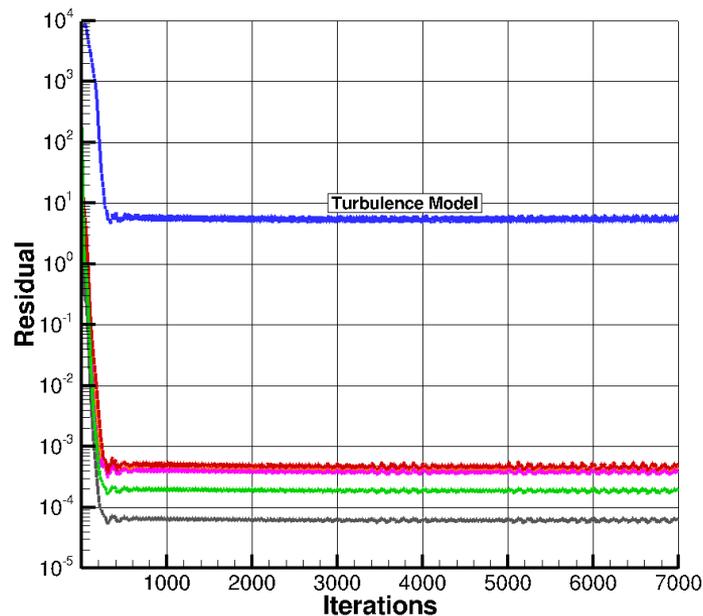
- Full Navier-Stokes
- Node centered
- Spalart-Allmaras turbulence model
 - Fully turbulent
 - Rotation and Curvature model (SARC) used
- Limiter not used

Case 1

- Grid convergence study
- Mach 0.175
- Reynolds number: 15.1 M
- Required alphas: 7 & 16 degrees
- Coarse, Medium, Fine grids

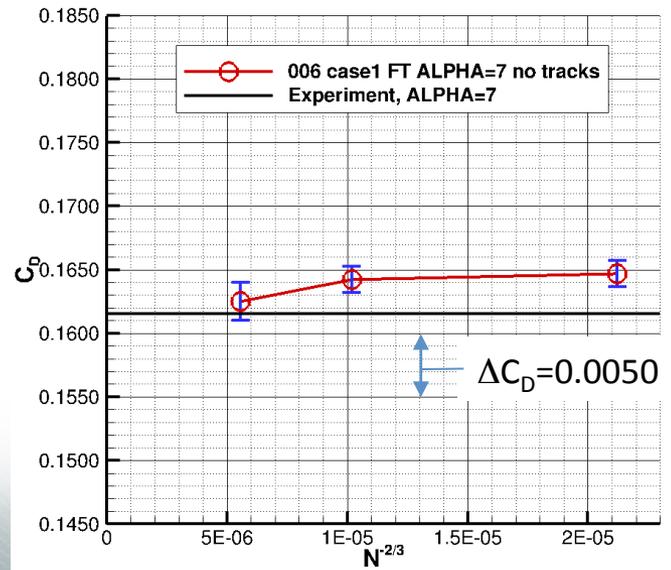
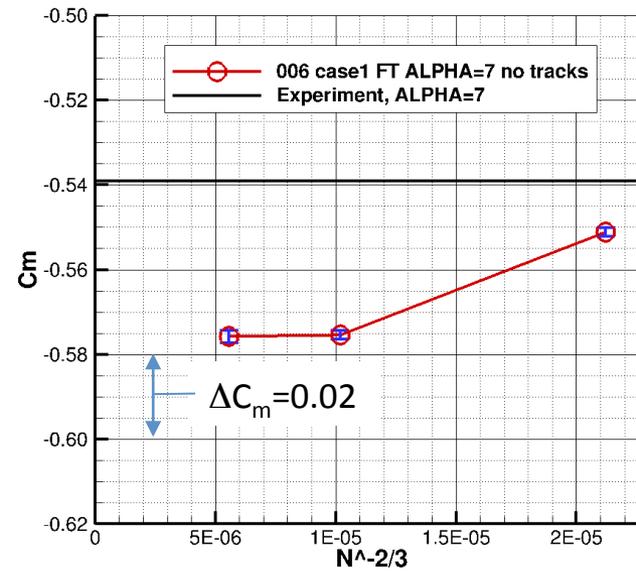
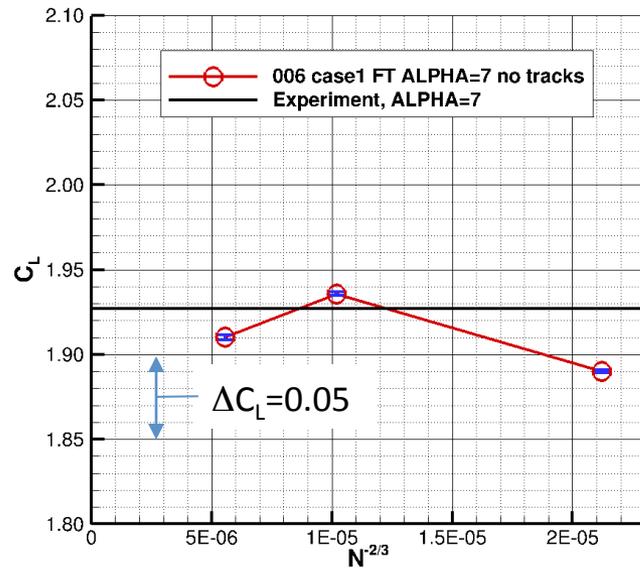
Residuals

- Initial solution was obtained at 2 degrees
- All cases were restarted from previous angles of attack
- All cases were run for 7000 iterations
- Residuals tend to hang

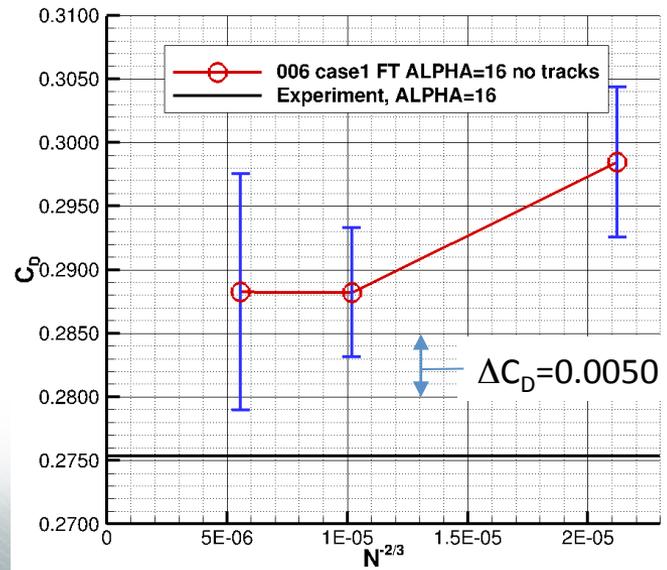
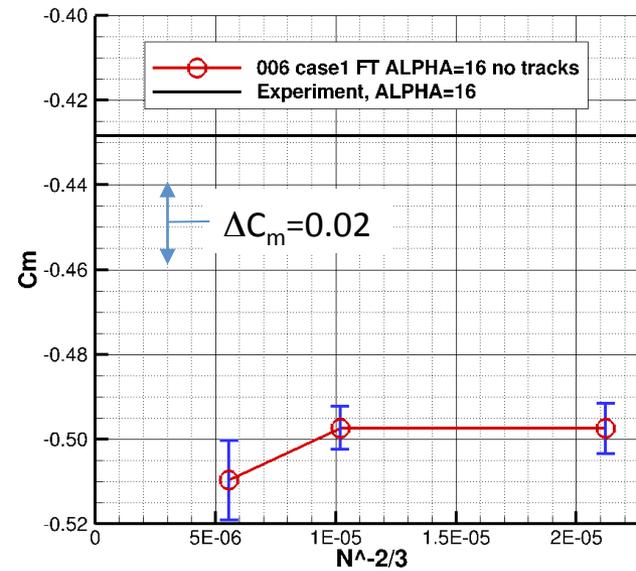
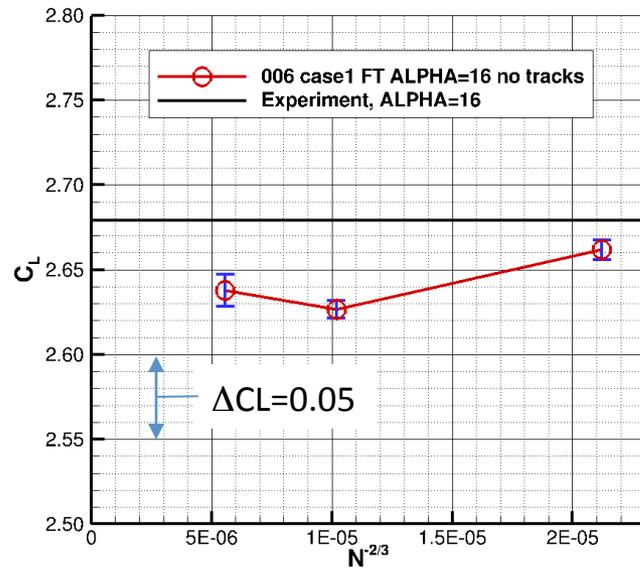


Convergence at 7 degrees

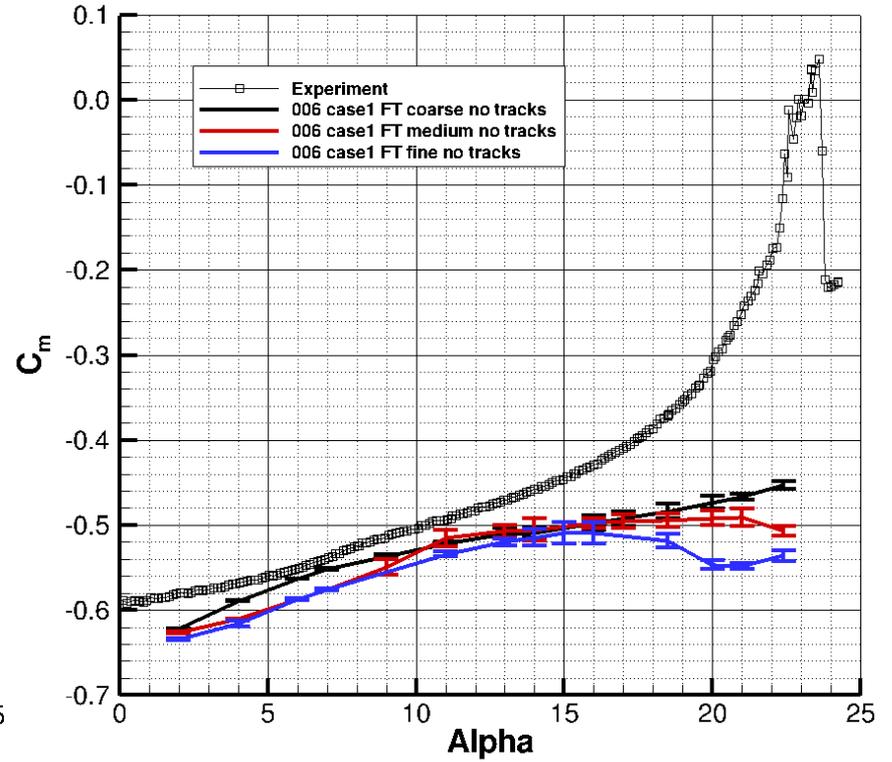
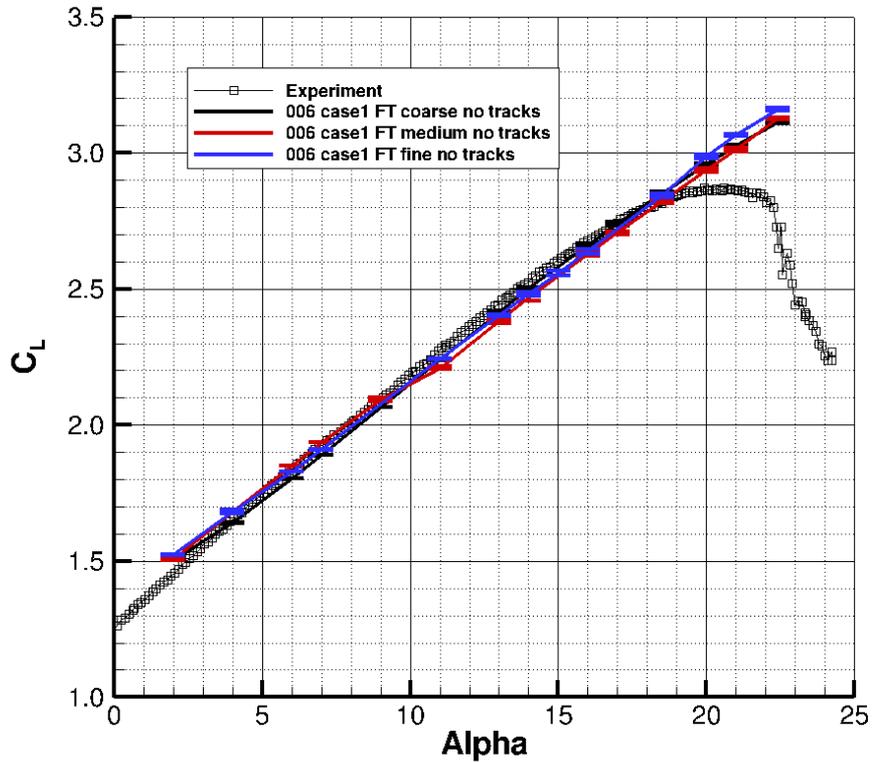
Grid Convergence, Alpha=7 degrees



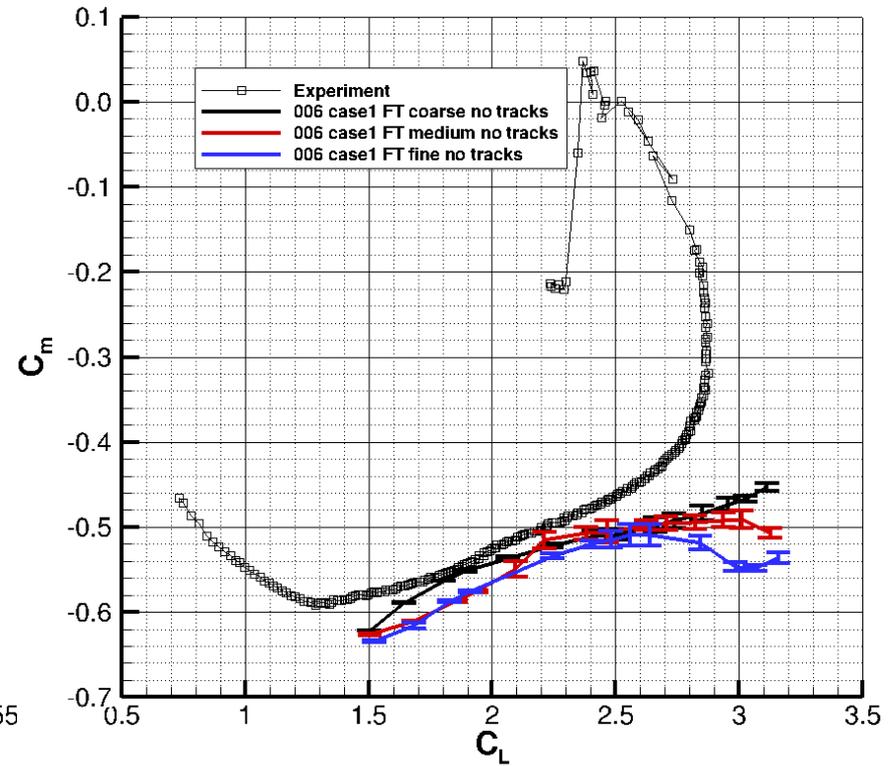
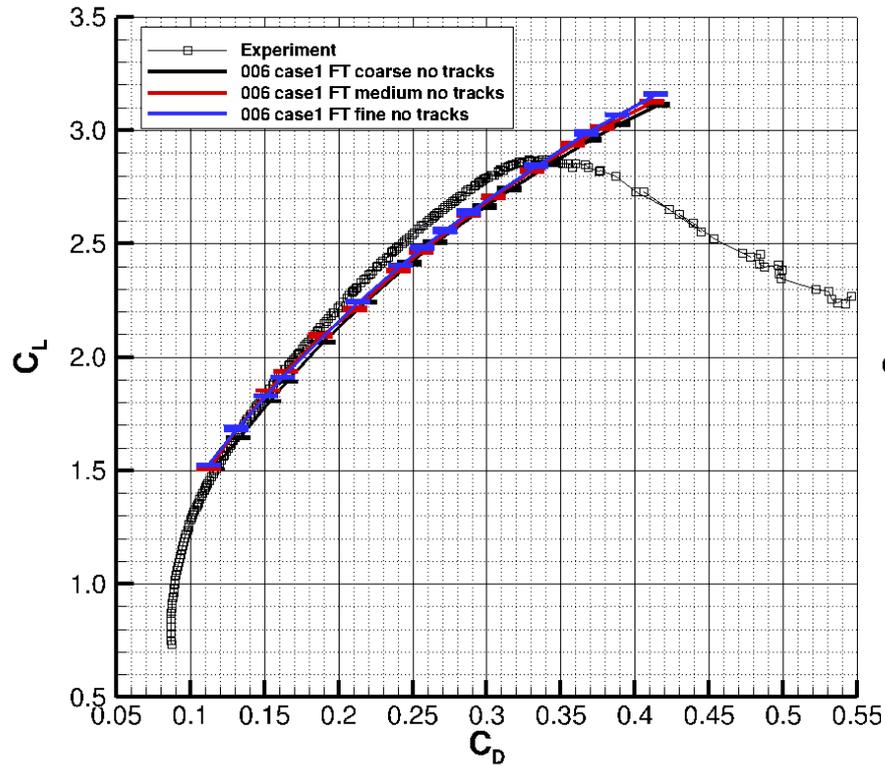
Grid Convergence, Alpha=16 degrees



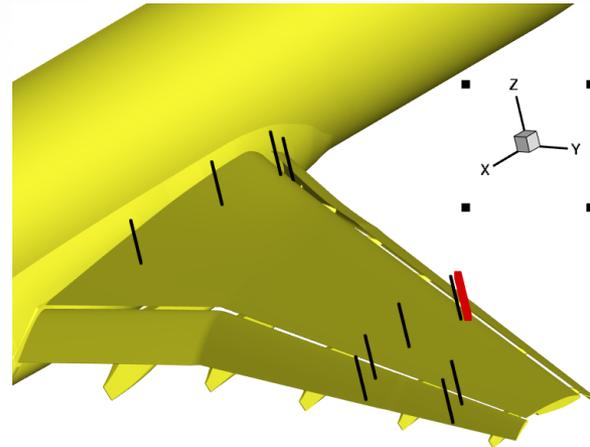
Lift and Pitching moment



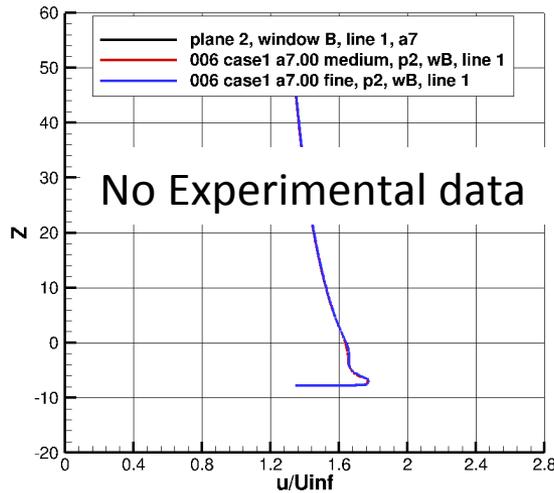
Drag and Pitching moment



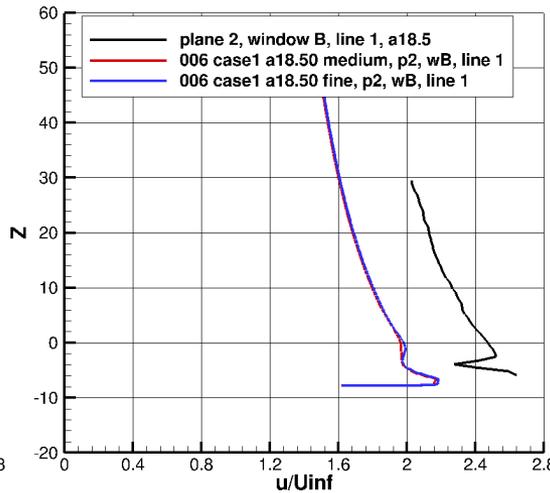
Velocity profiles, Medium and Fine grids



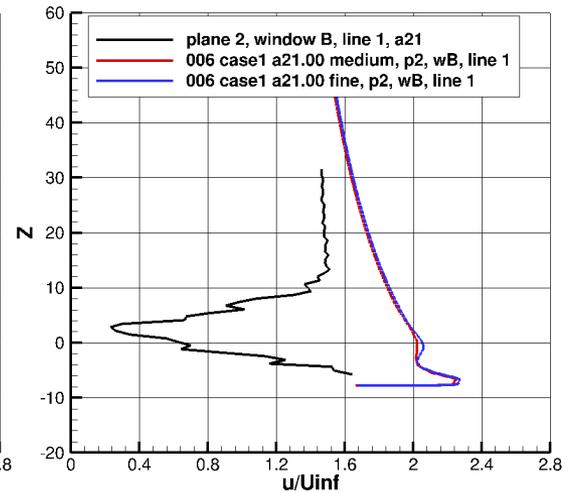
Experiment $Re=1.35M$



7 degrees

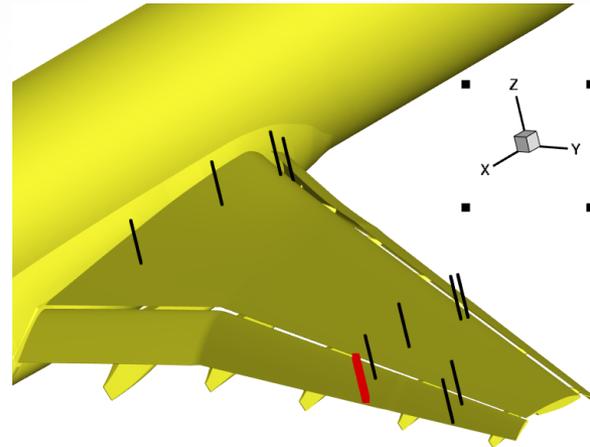


18.5 degrees

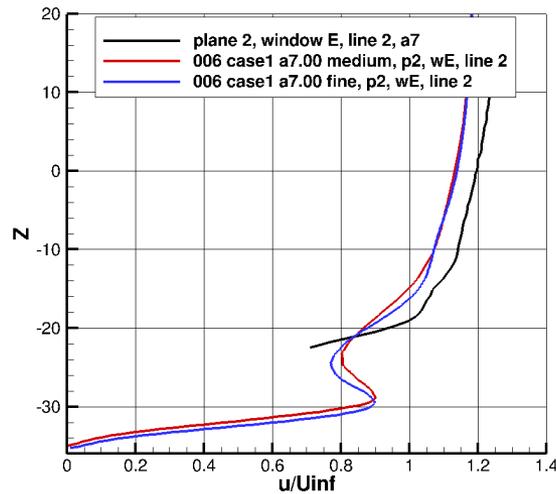


21 degrees

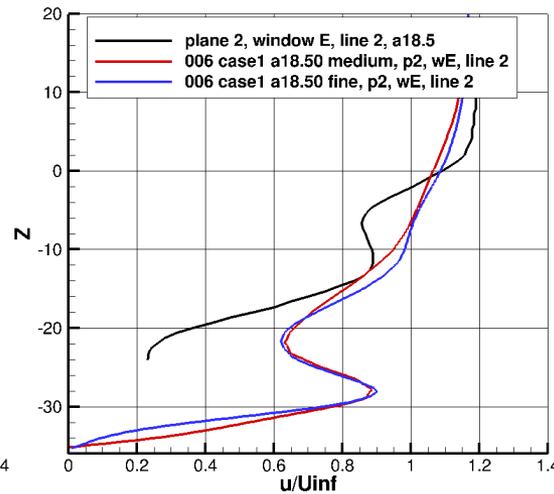
Velocity profiles, Medium and Fine grids



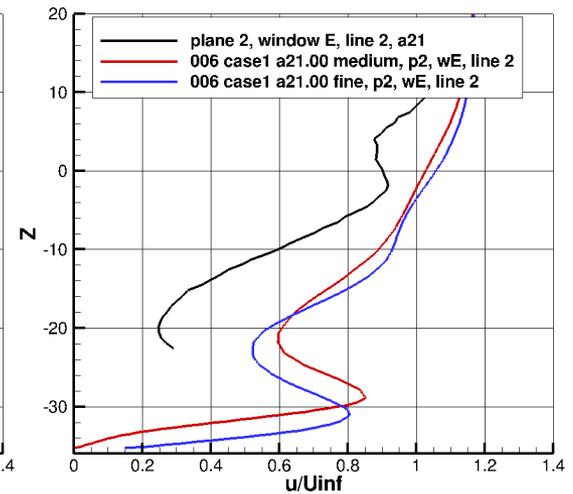
Experiment $Re=1.35M$



7 degrees

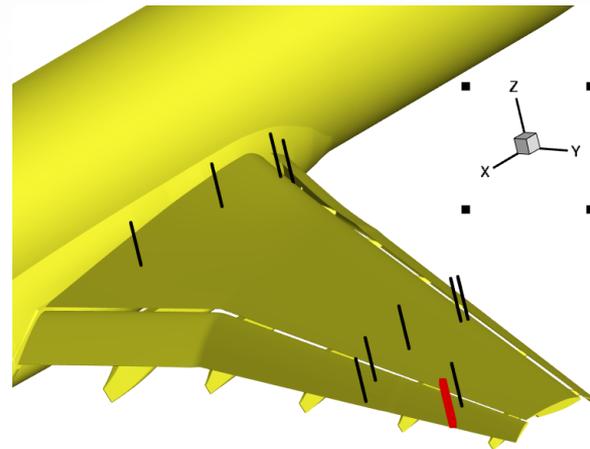


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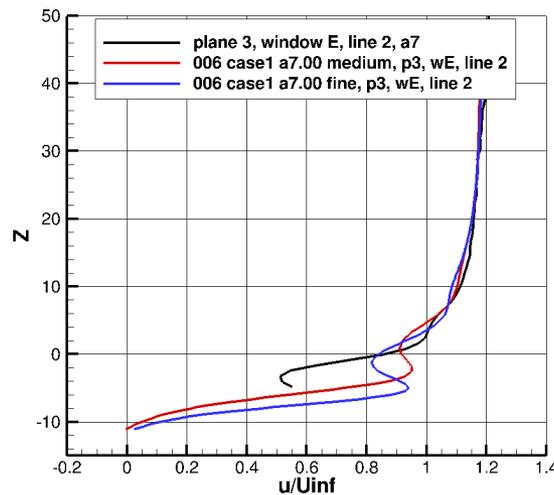


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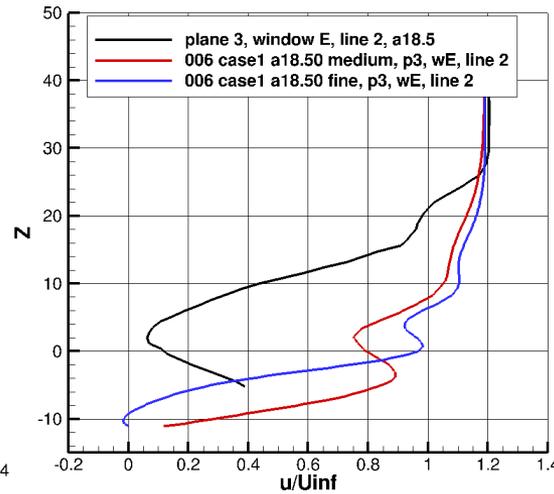
Velocity profiles, Medium and Fine grids



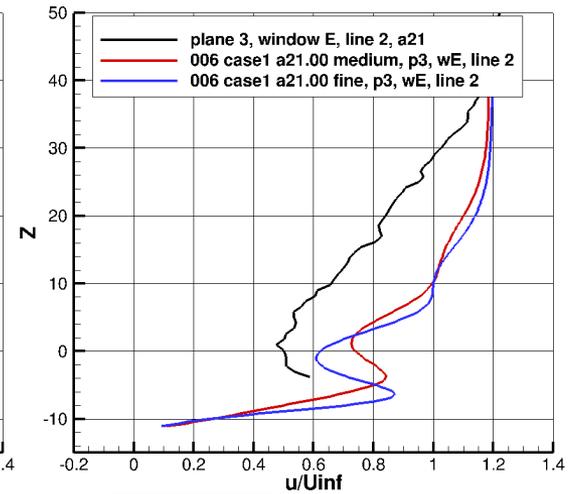
Experiment $Re=1.35M$



7 degrees

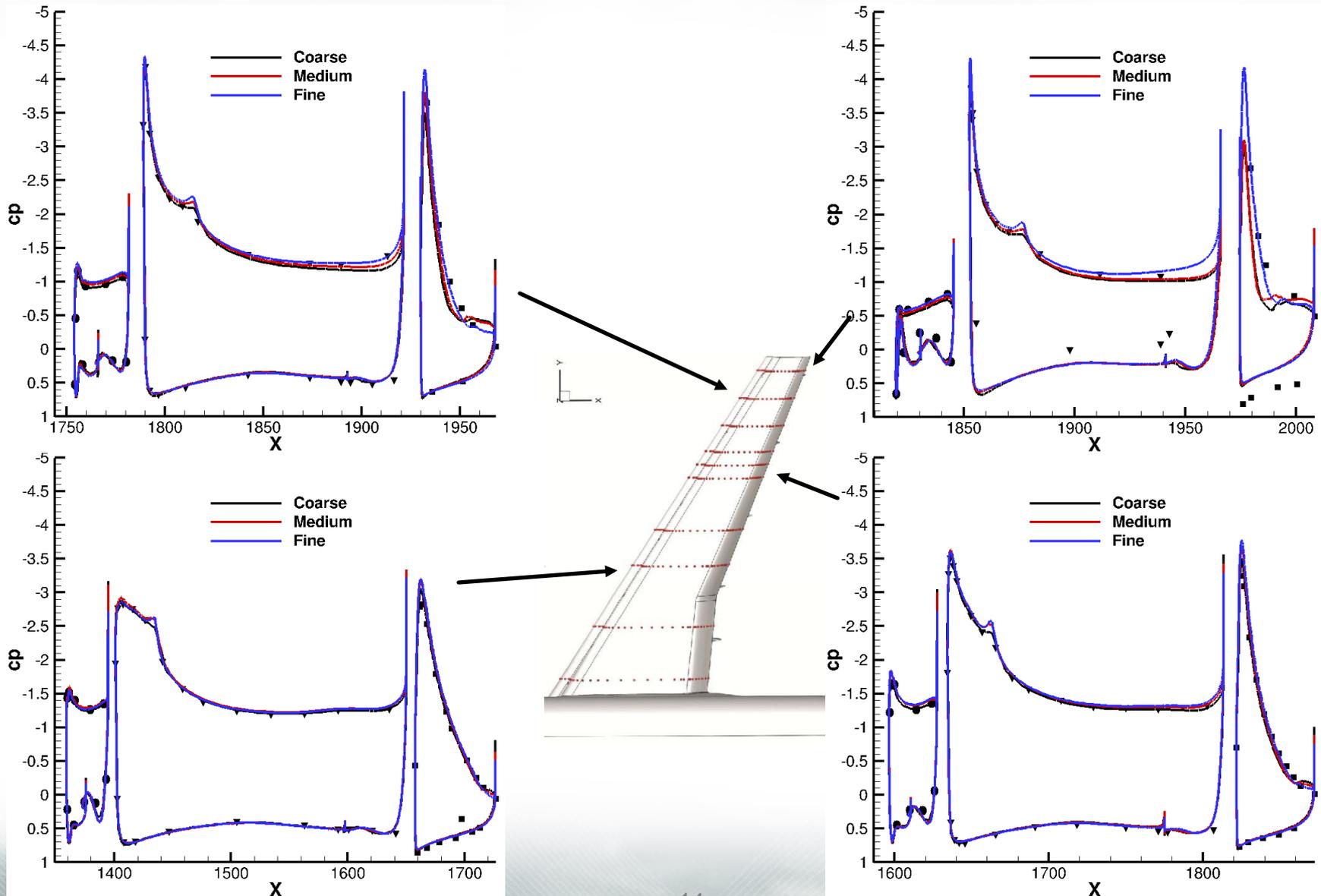


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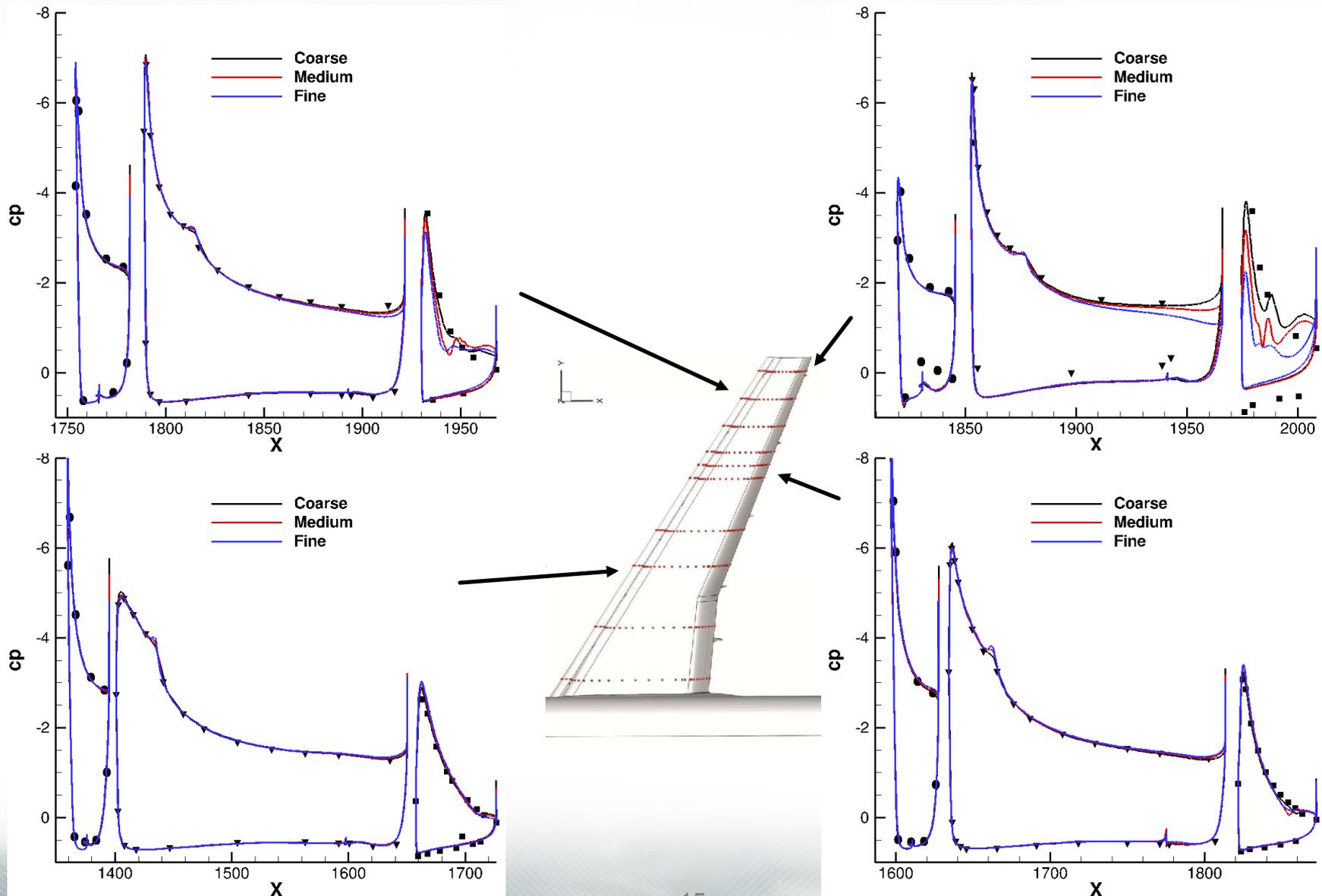


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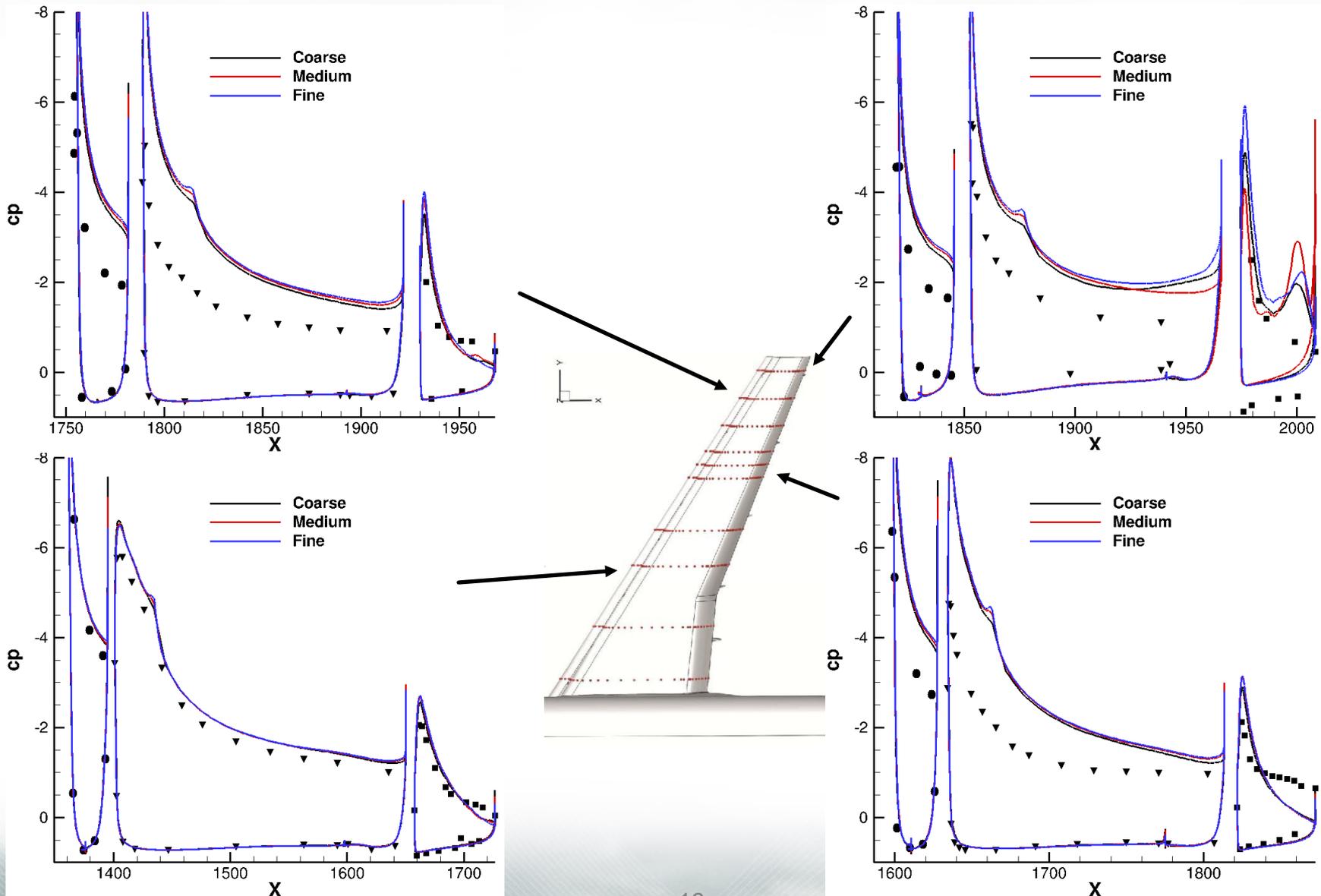
Case 1, Cp, Alpha = 7 degrees, Grid effects



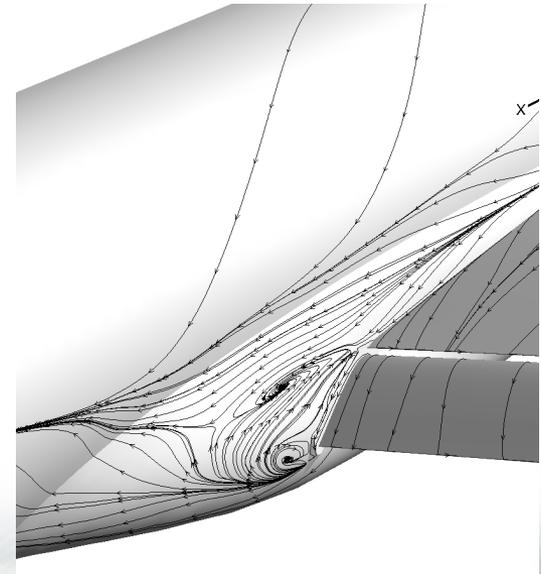
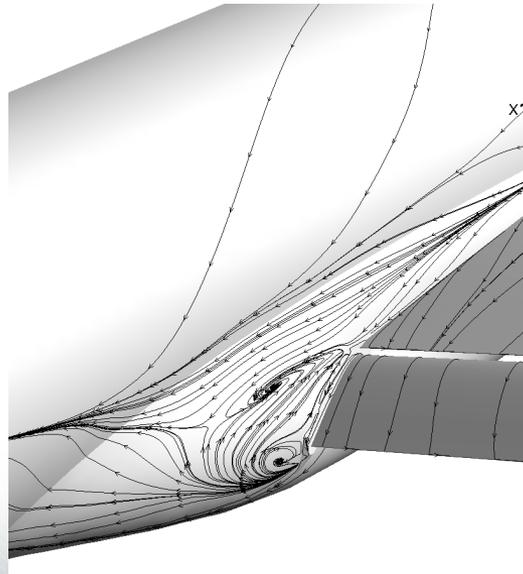
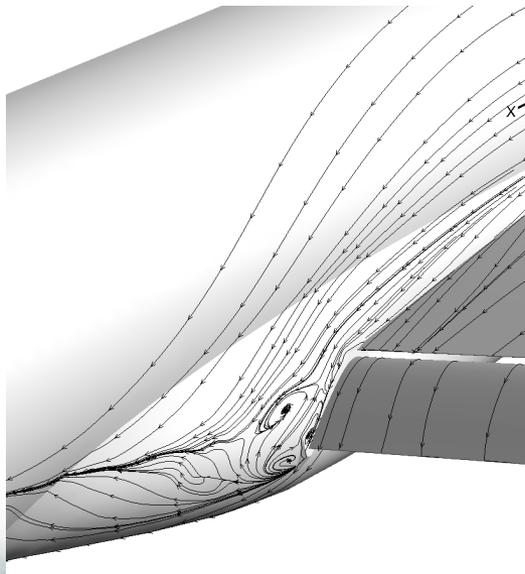
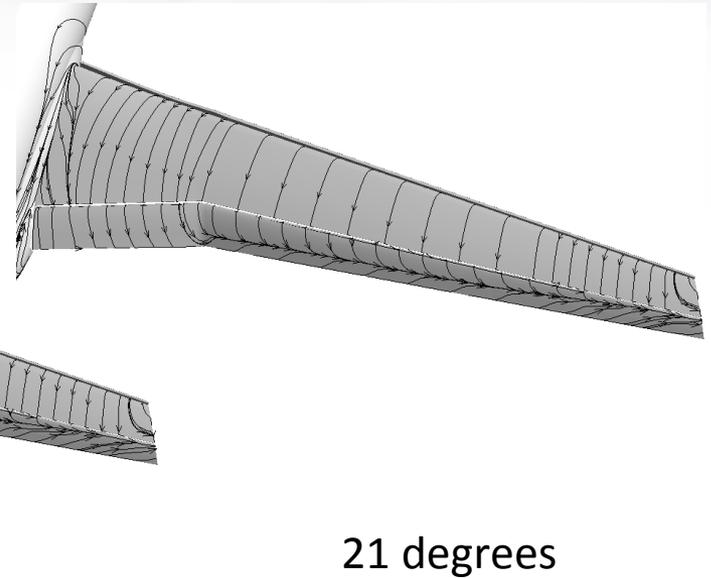
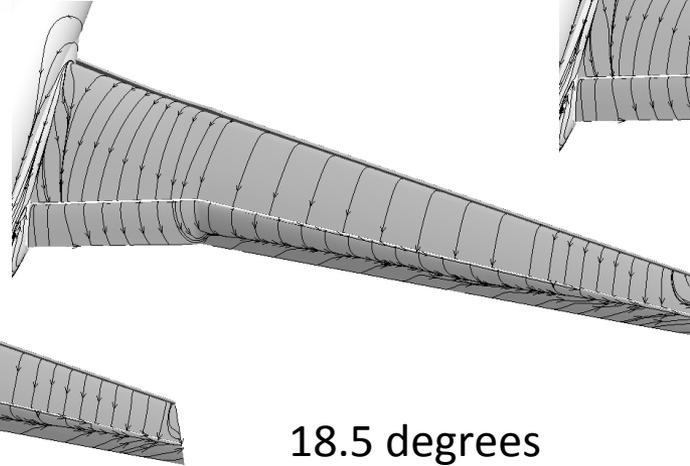
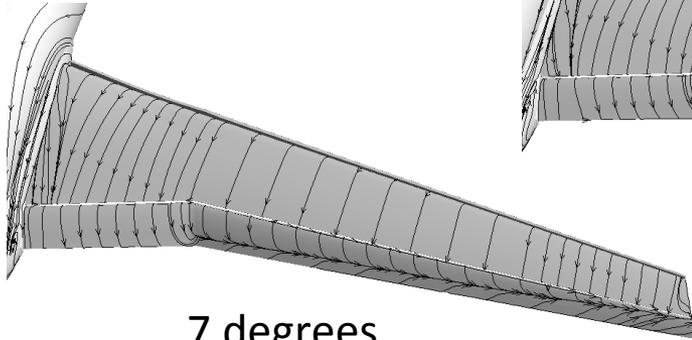
Case 1, Cp, Alpha = 16 degrees, Grid effects



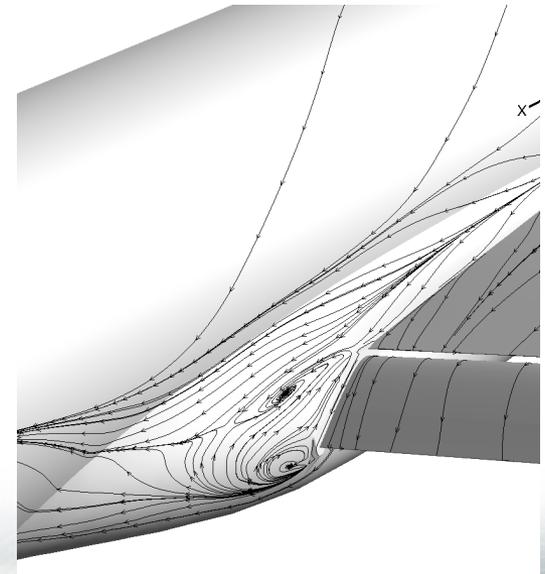
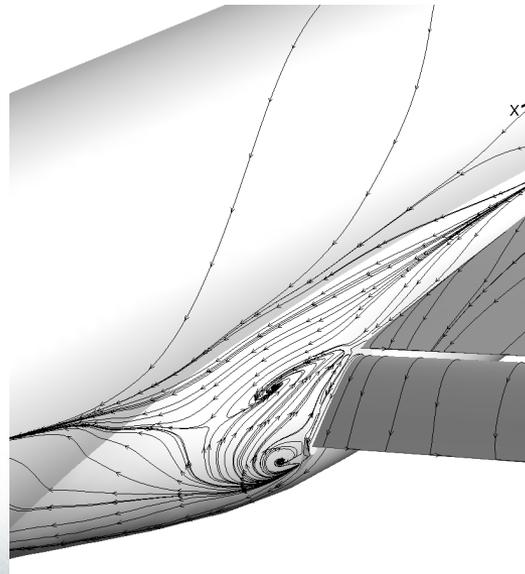
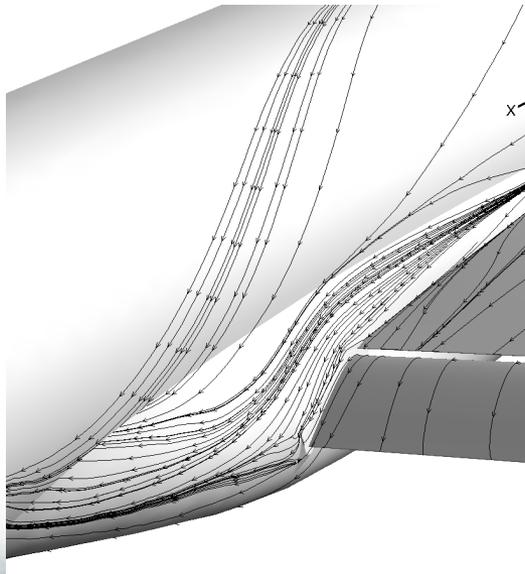
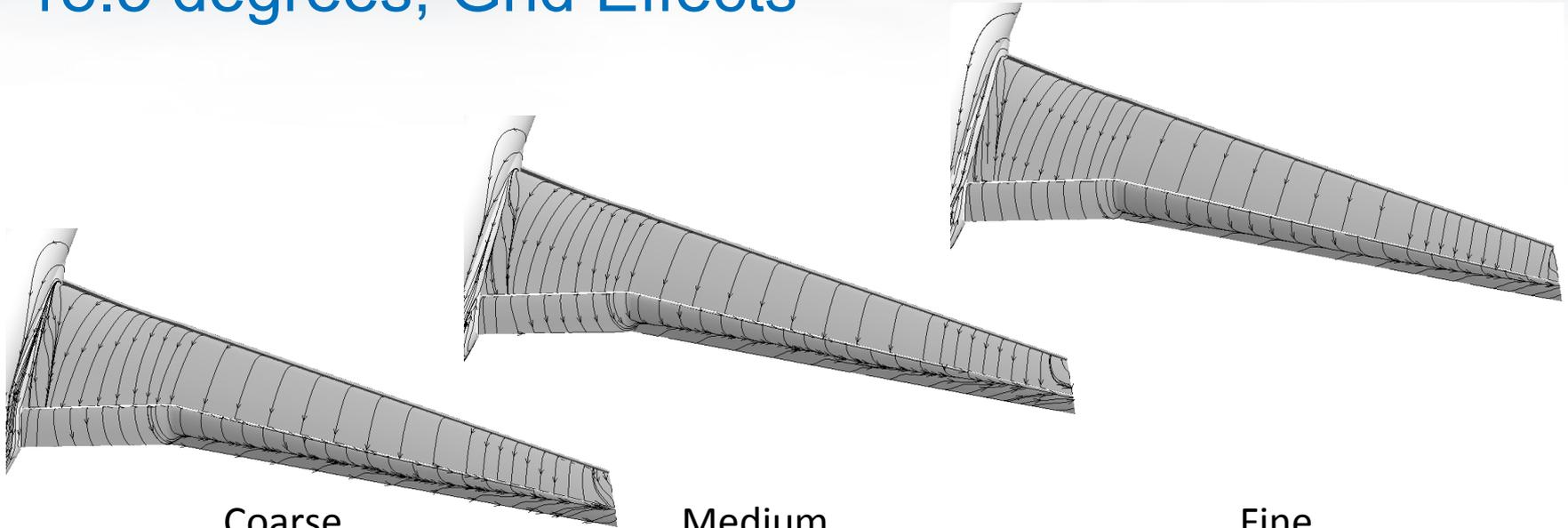
Case 1, Cp, Alpha = 22.4 degrees, Grid effects



Medium Grid, Alpha increasing



18.5 degrees, Grid Effects

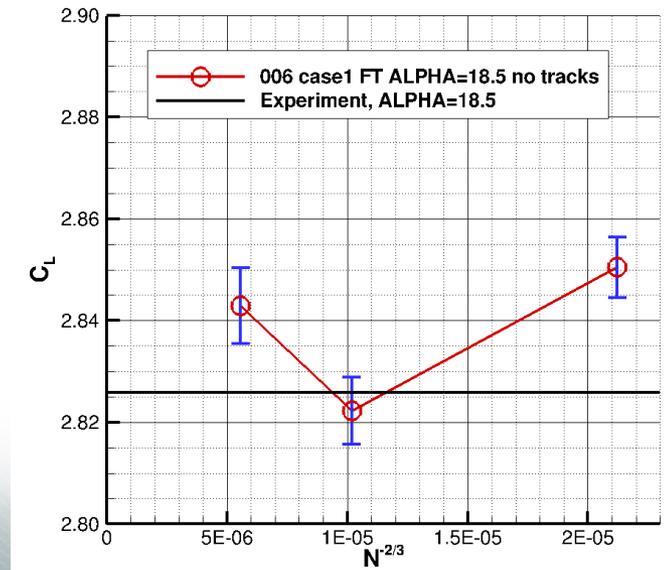
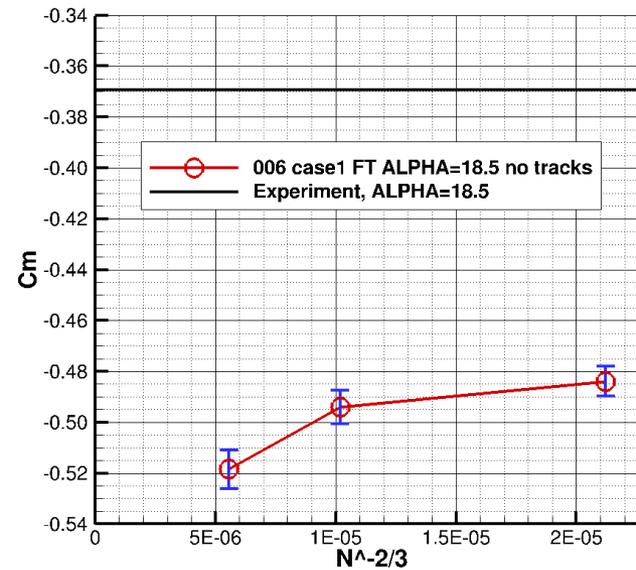
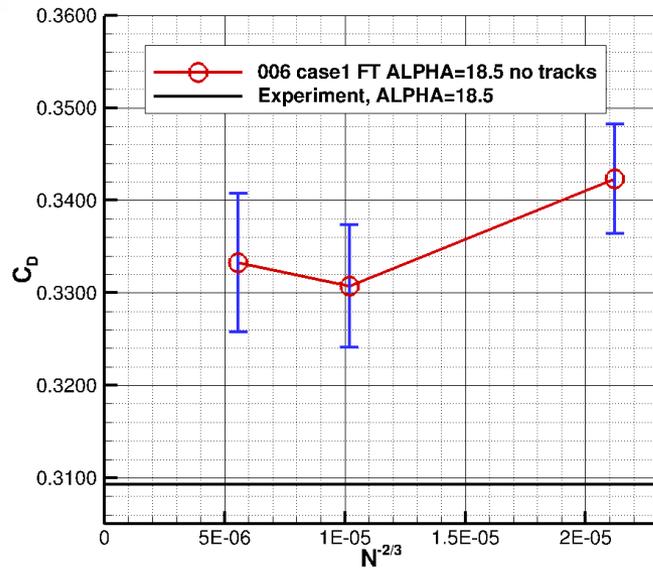


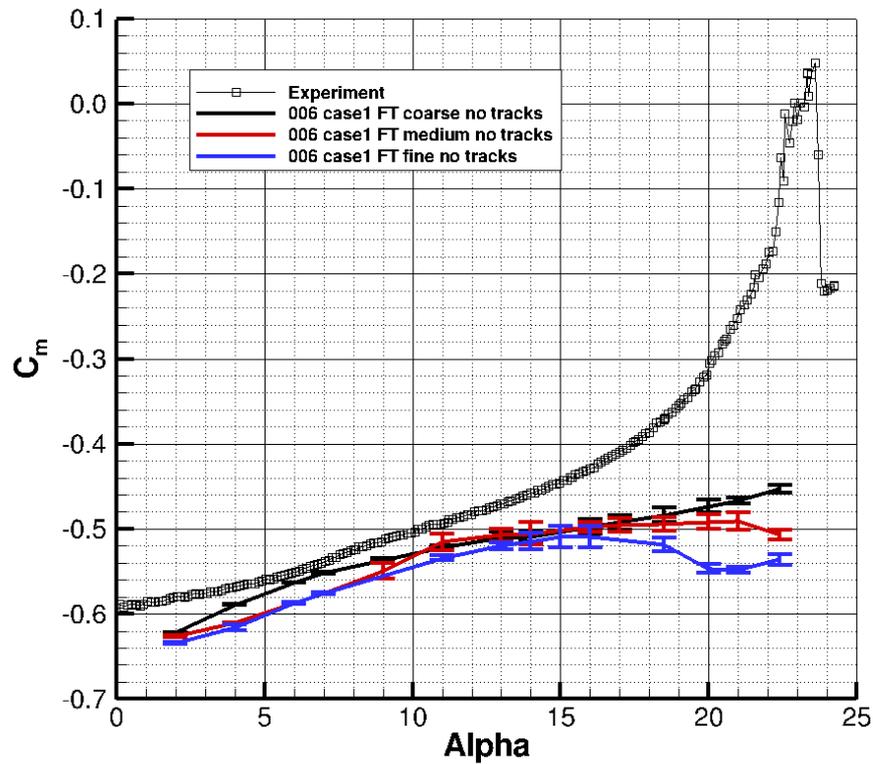
Conclusions

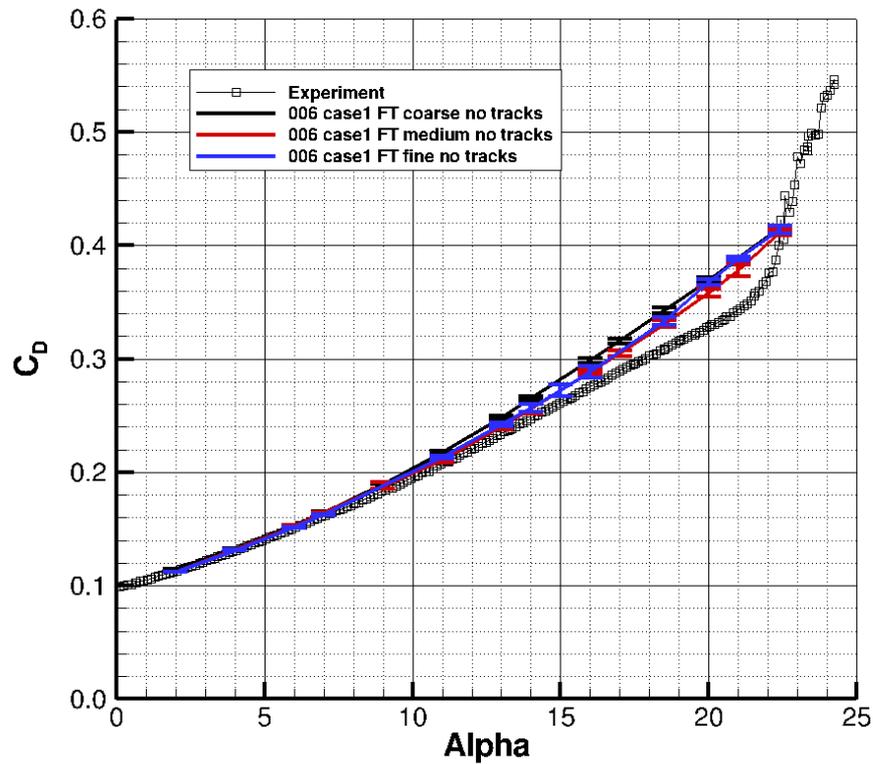
- In general, the agreement with experiment was disappointing, if not surprising.
- Clearly the CFD is not capturing the pertinent physics.
- Bracket effects are likely to be more critical for this geometry than they were for the Trap Wing simply because of their relative size.
- Workshop grid paradigm may need modifications.
 - Not possible to strictly adhere to gridding guidelines and still be able to achieve a family of grids, at least with Vgrid at this time.
 - Requirement of grid family meant significant deviations from “best practices” had to be made.
 - Would suggest future workshops include actual “best practice” grid that represents type of grids used in real world.

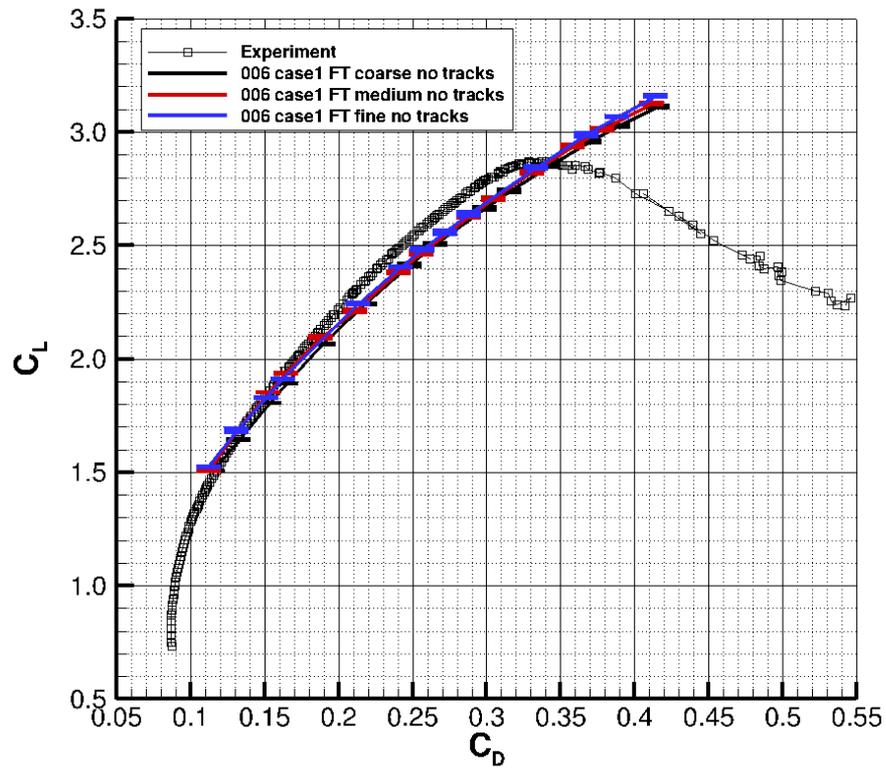
EXTRA SLIDES

Grid Convergence, Alpha=18.5

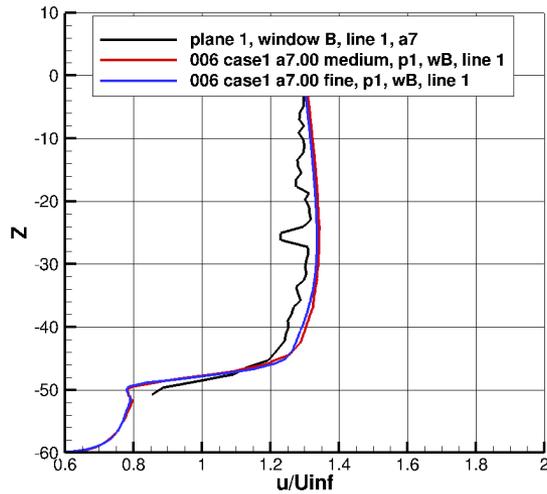
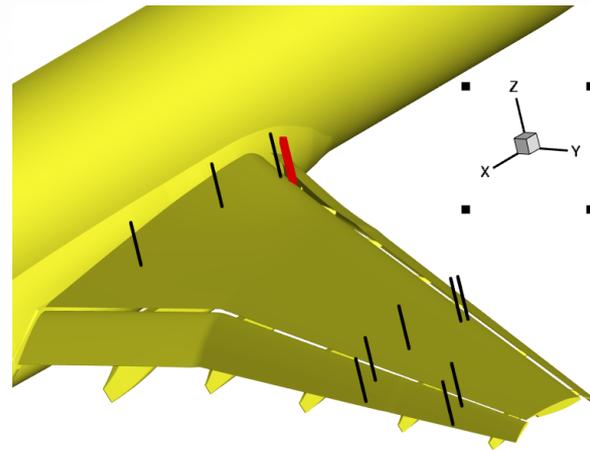




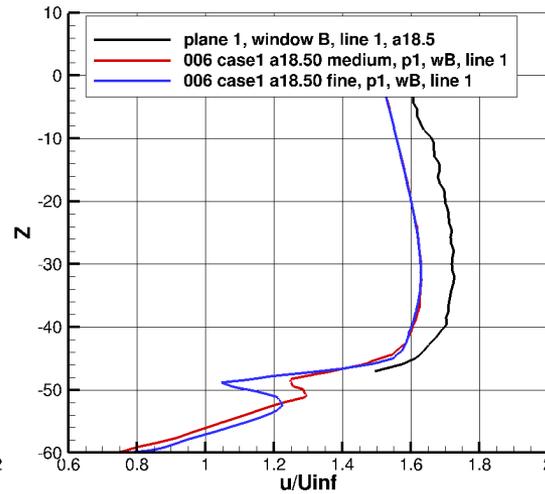




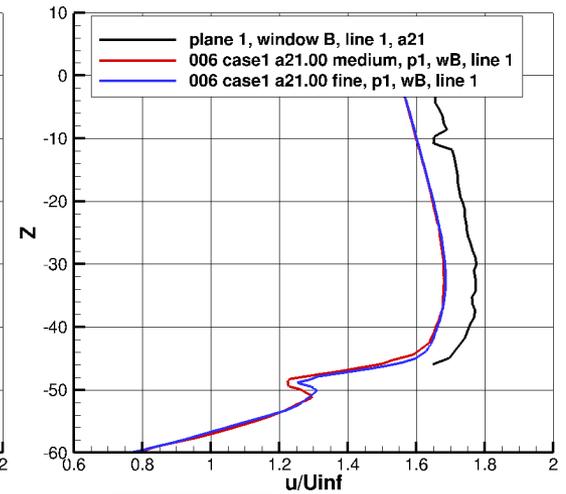
Velocity profiles



7 degrees

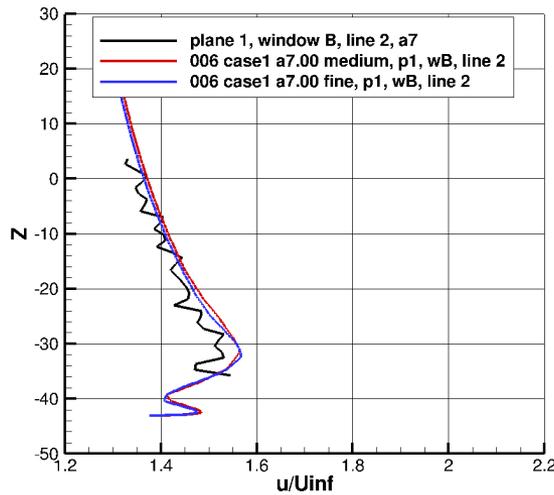
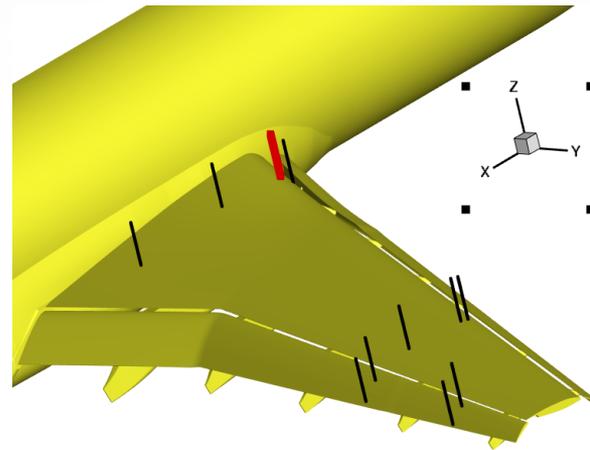


18.5 degrees

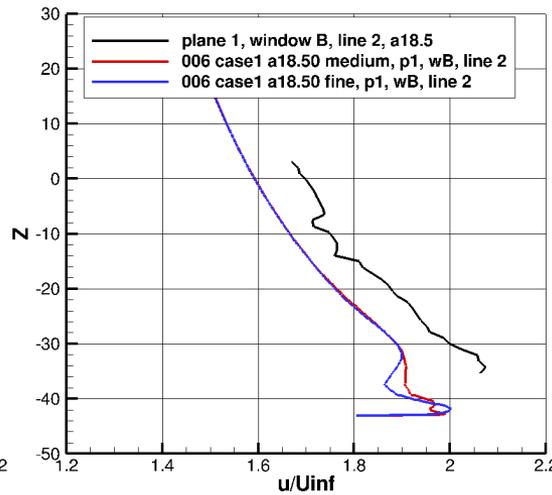


21 degrees

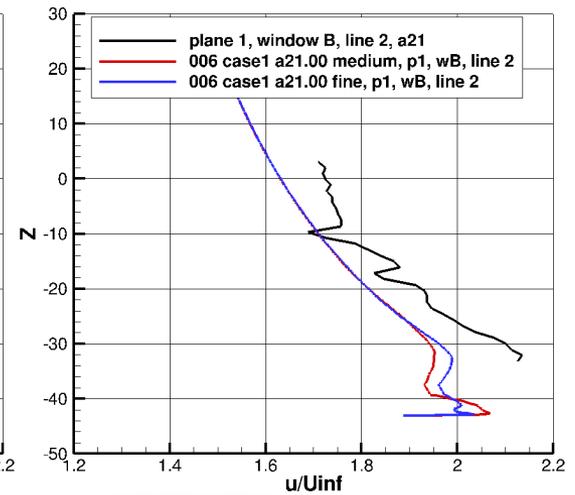
Velocity profiles



7 degrees

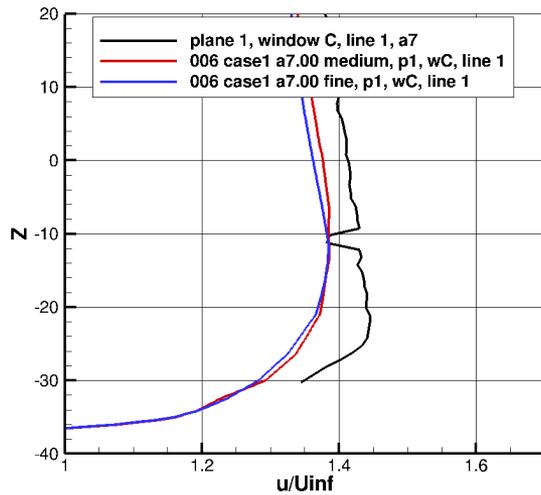
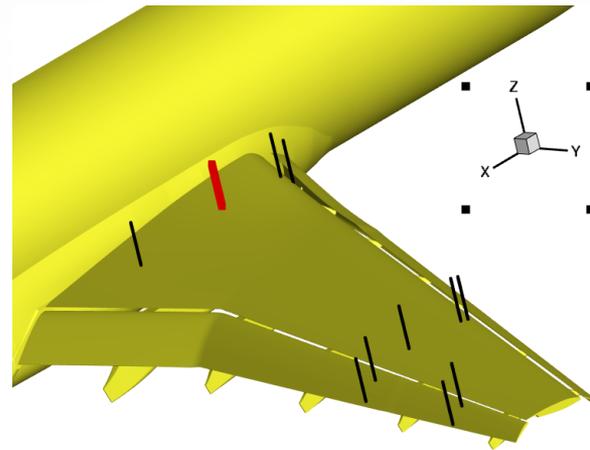


18.5 degrees

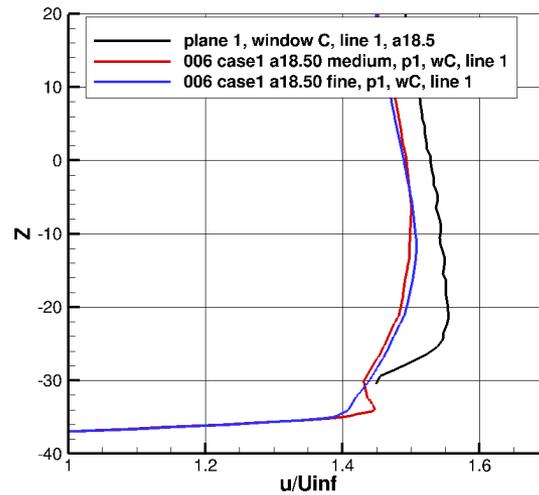


21 degrees

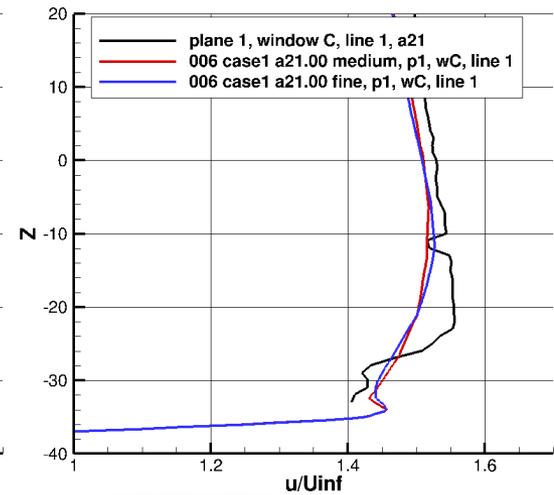
Velocity profiles



7 degrees

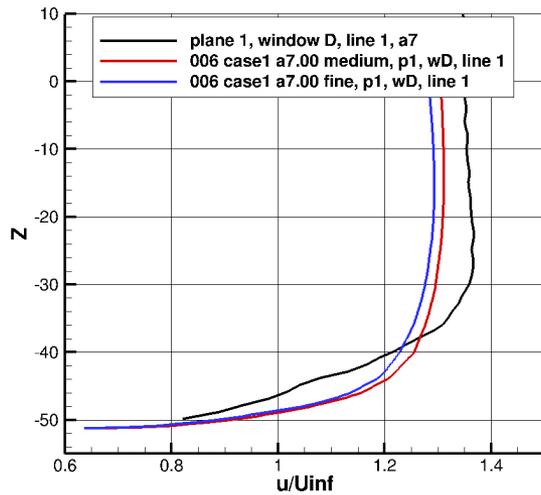
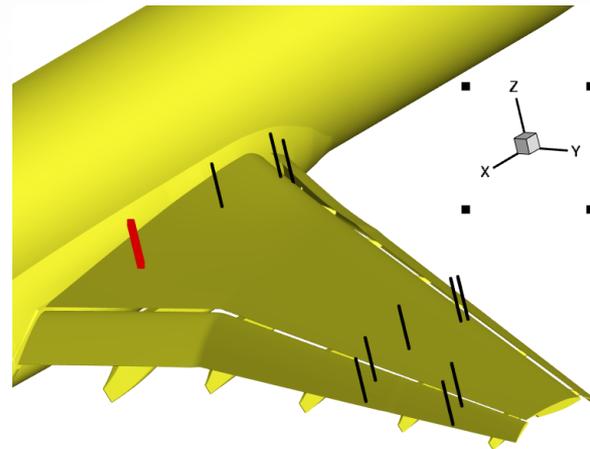


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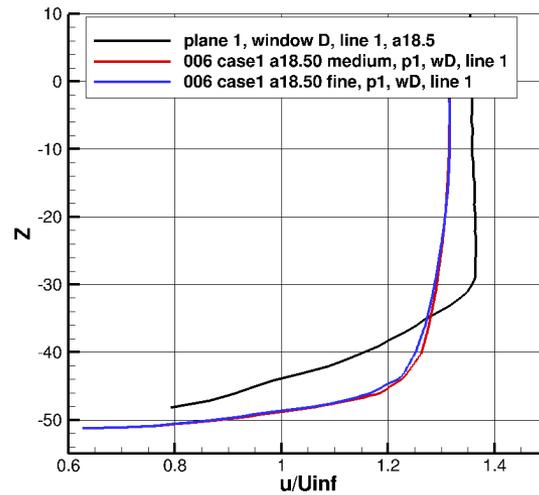


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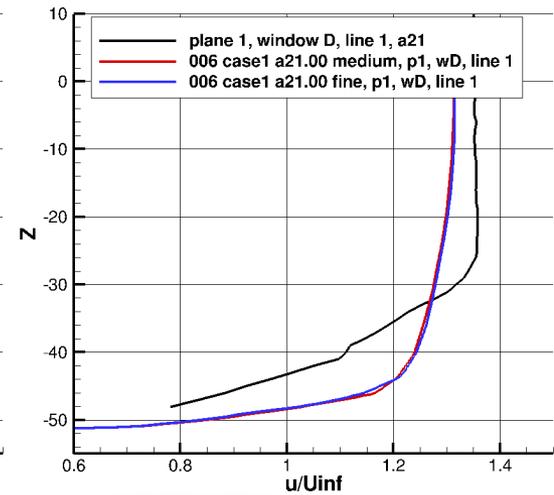
Velocity profiles



7 degrees

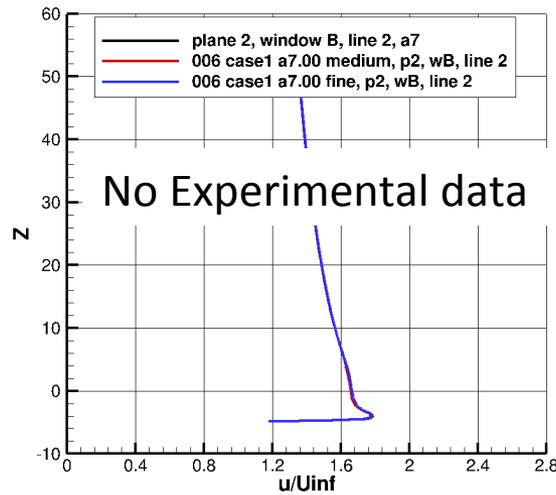
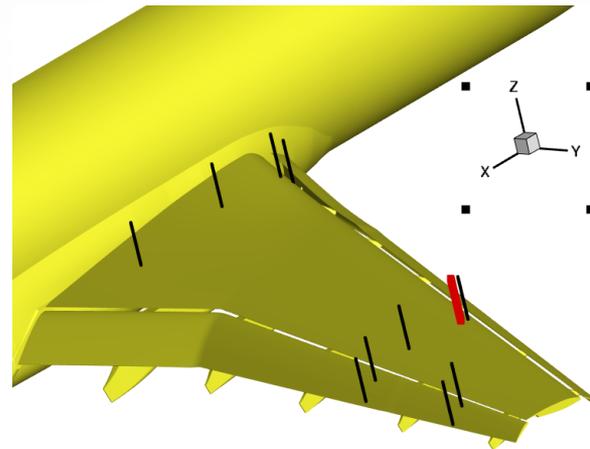


18.5 degrees

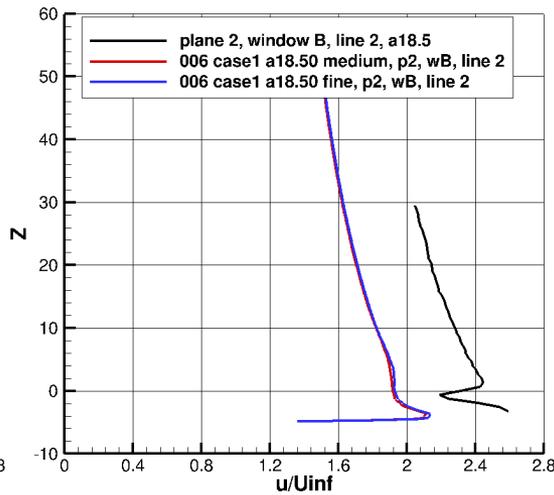


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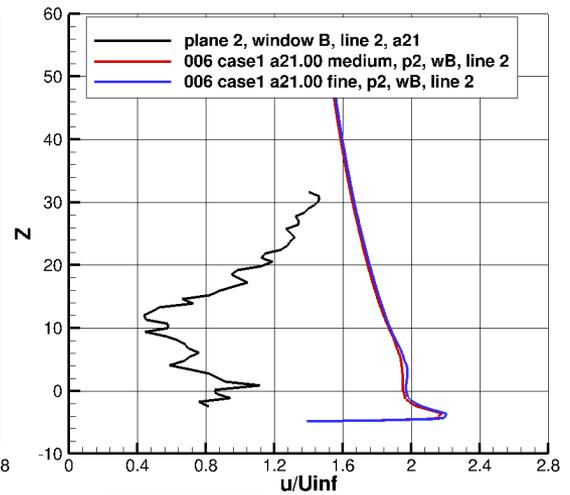
Velocity profiles



7 degrees

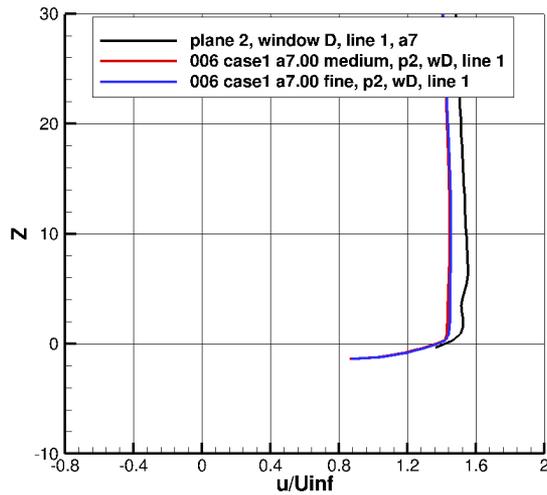
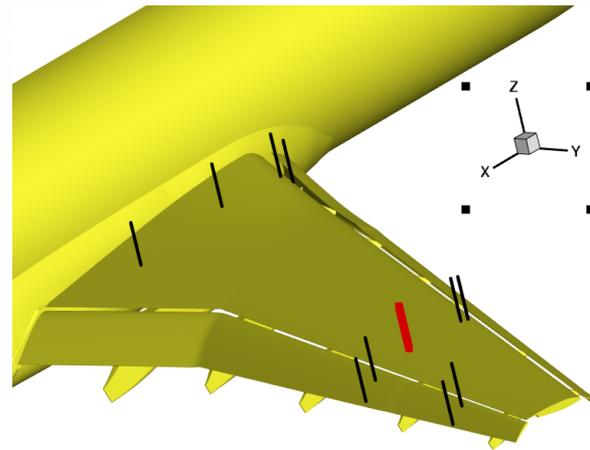


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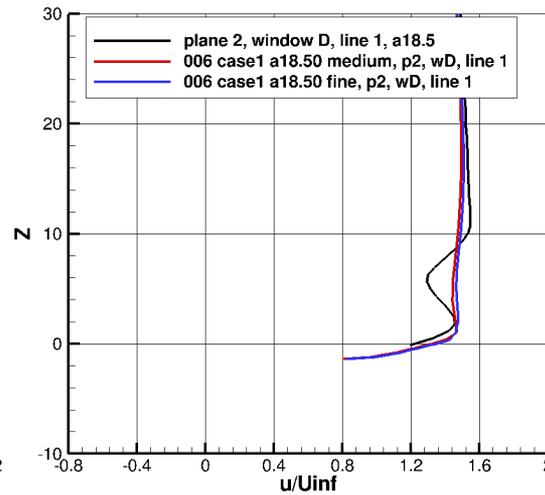


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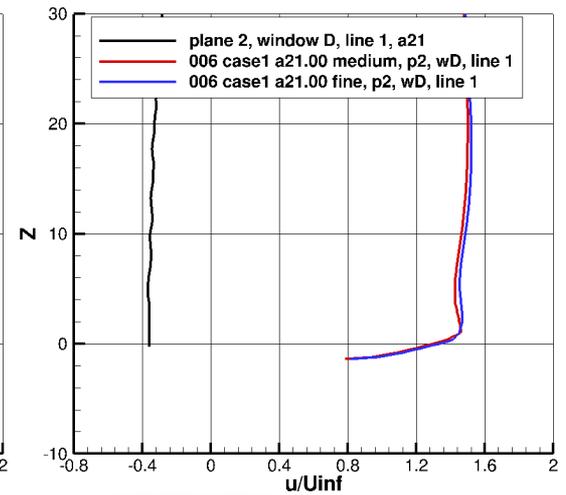
Velocity profiles



7 degrees

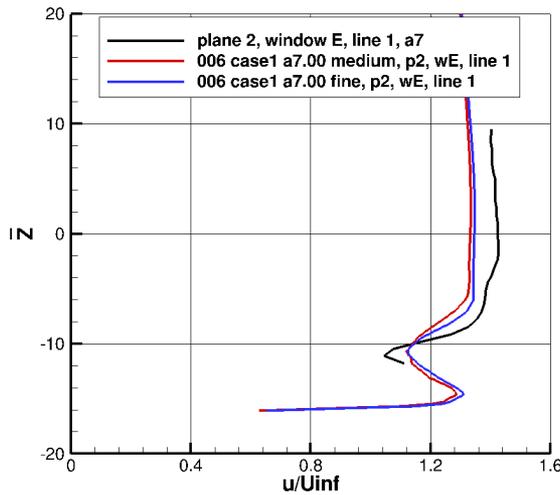
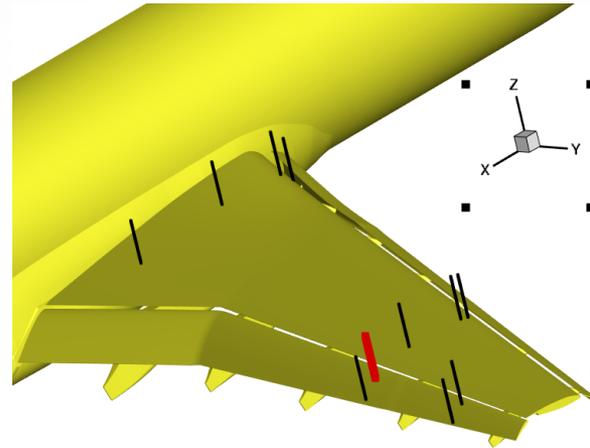


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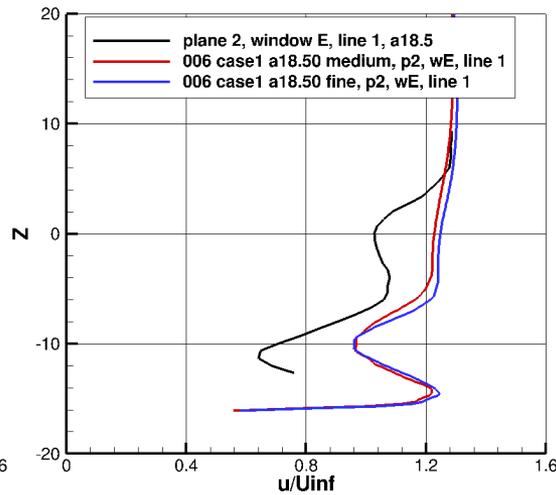


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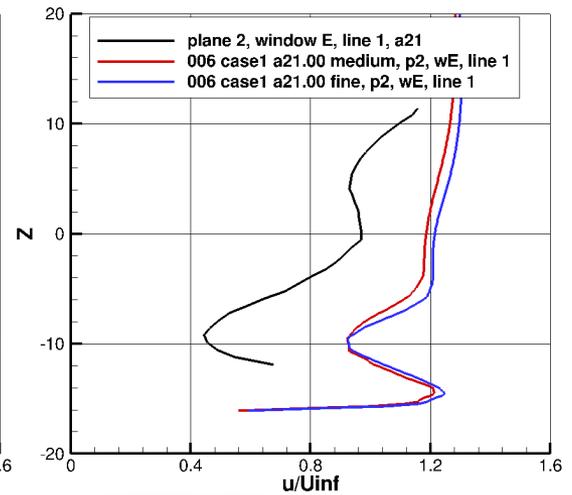
Velocity profiles



7 degrees

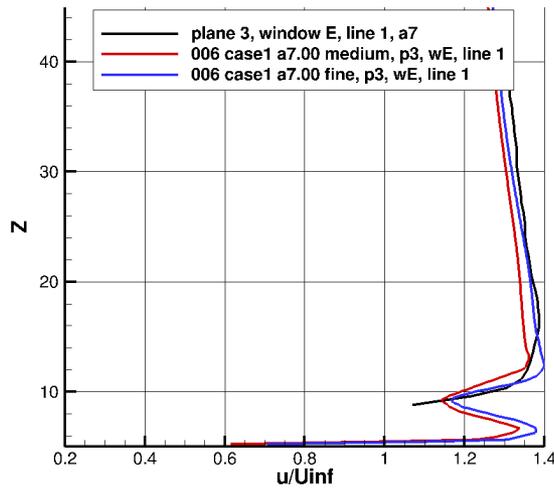
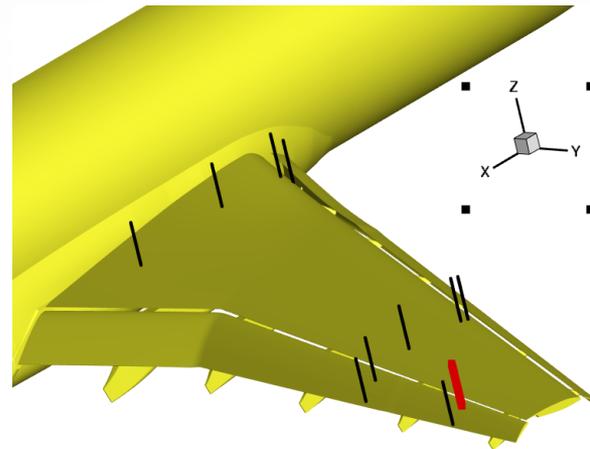


18.5 degrees

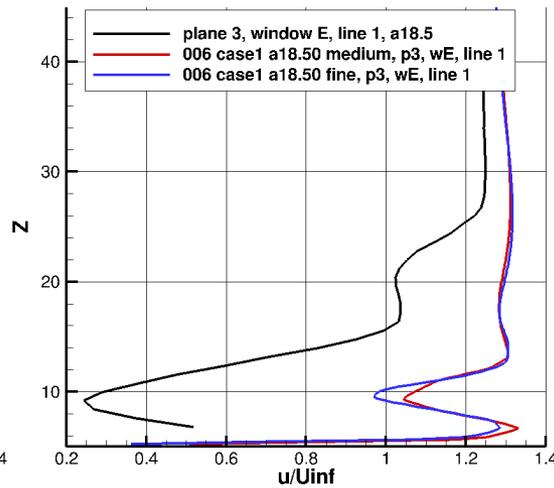


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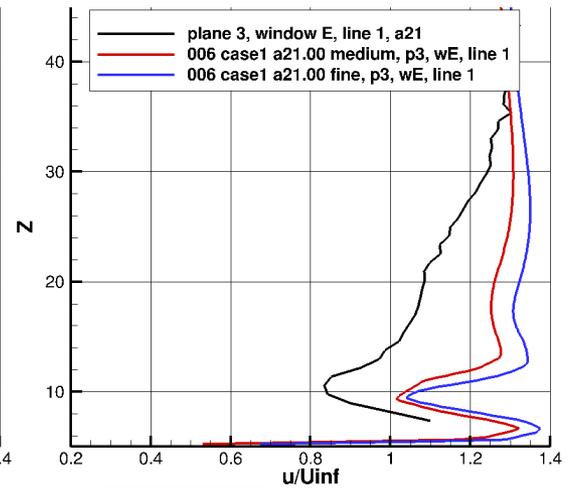
Velocity profiles



7 degrees

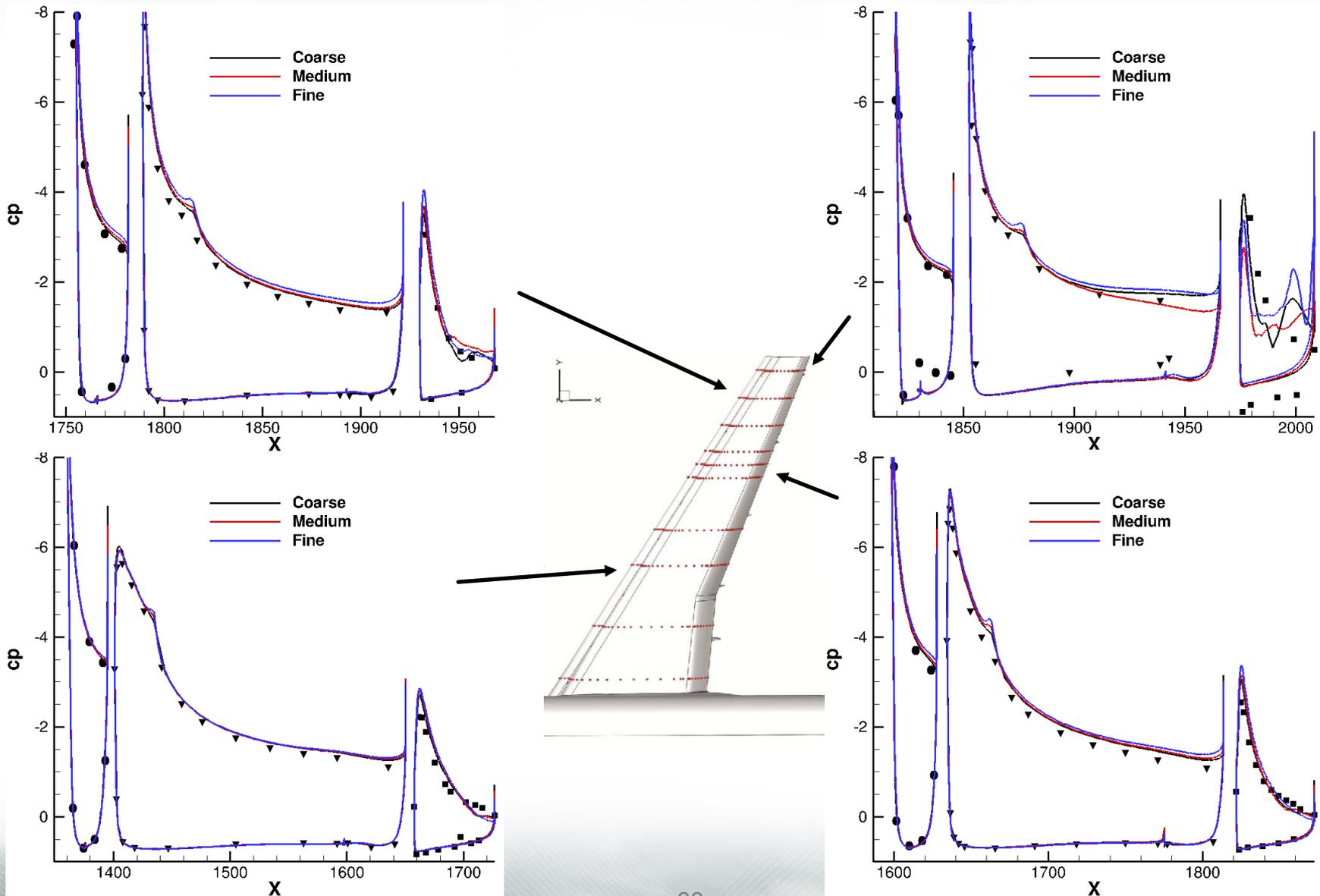


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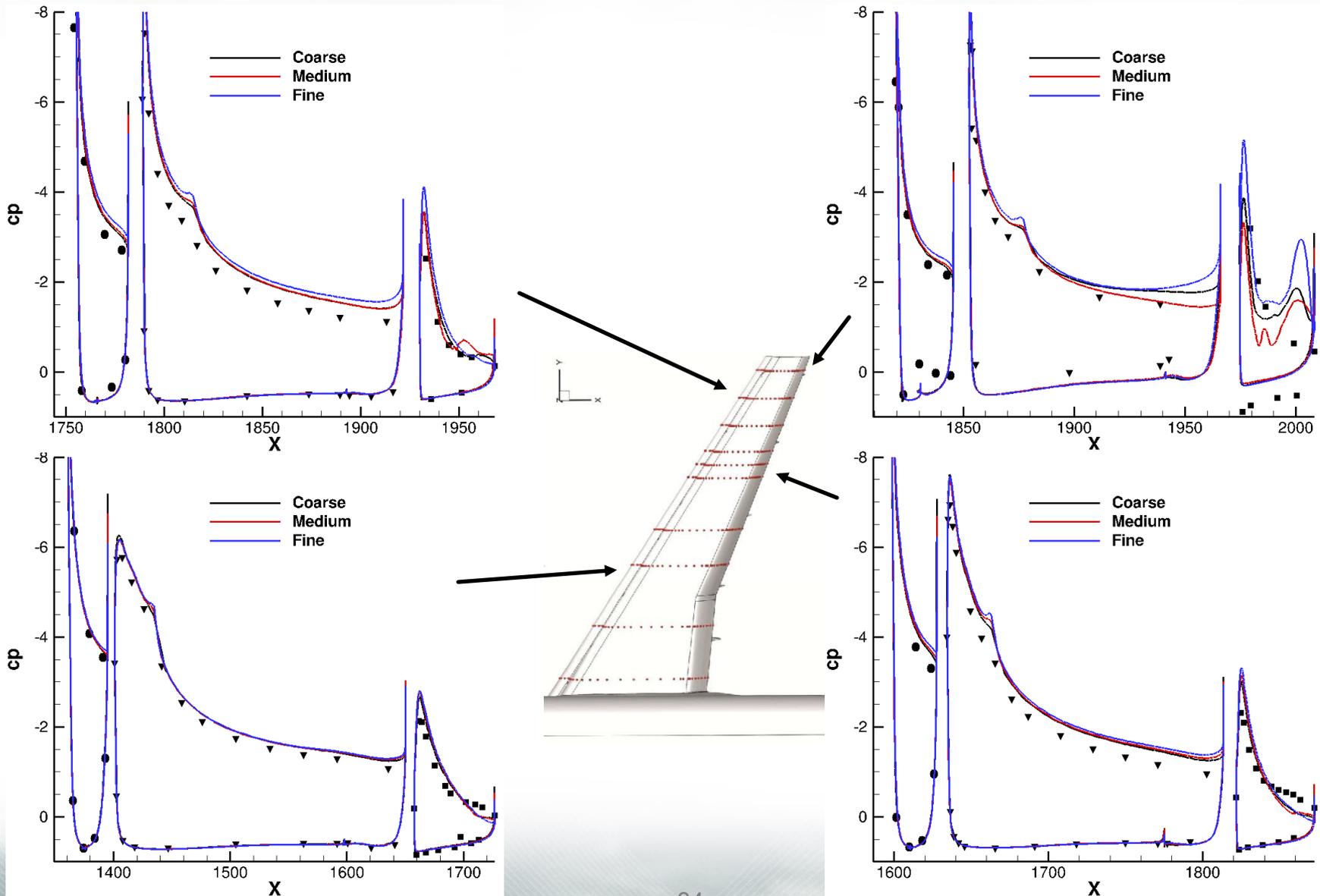


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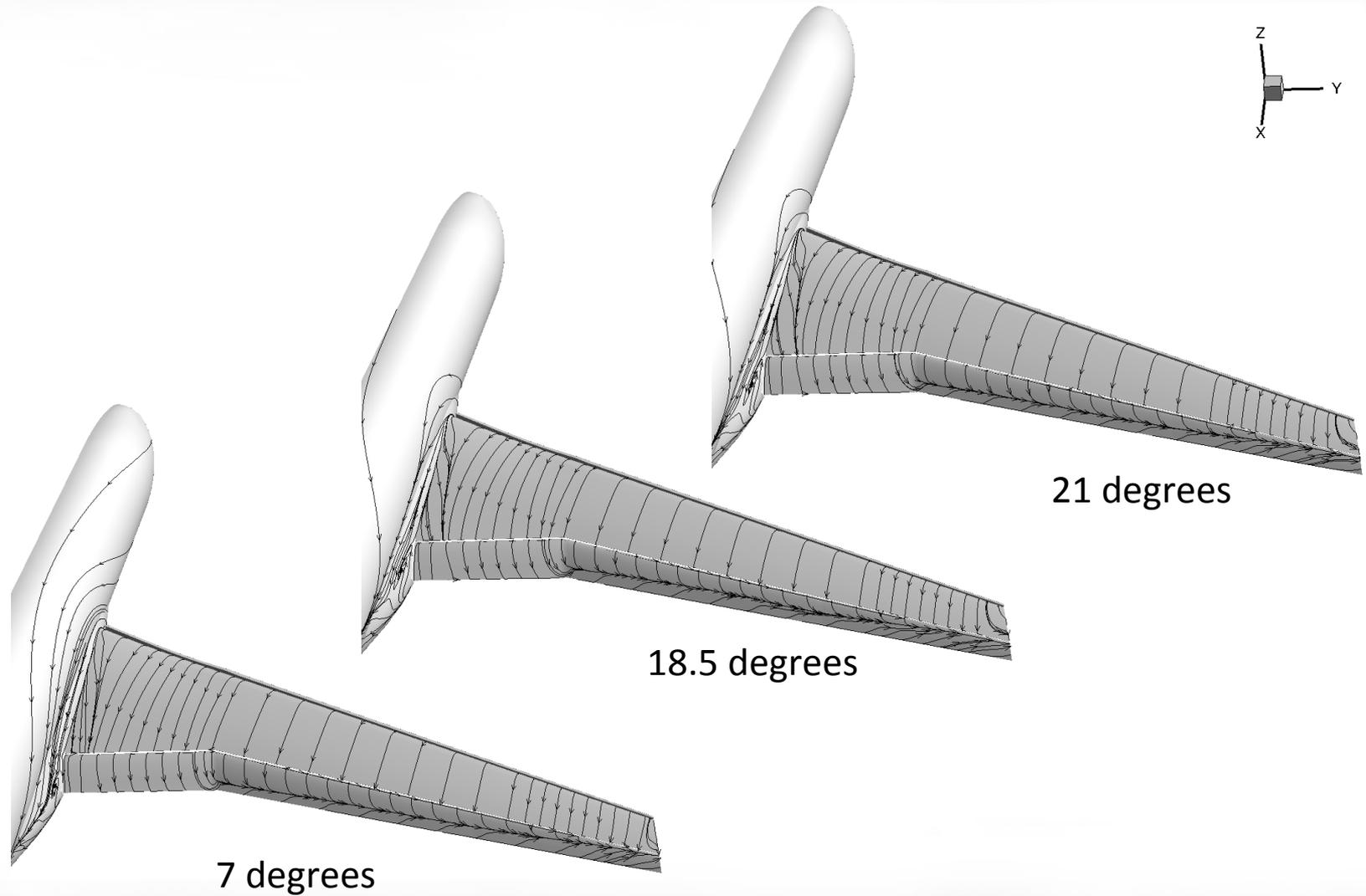
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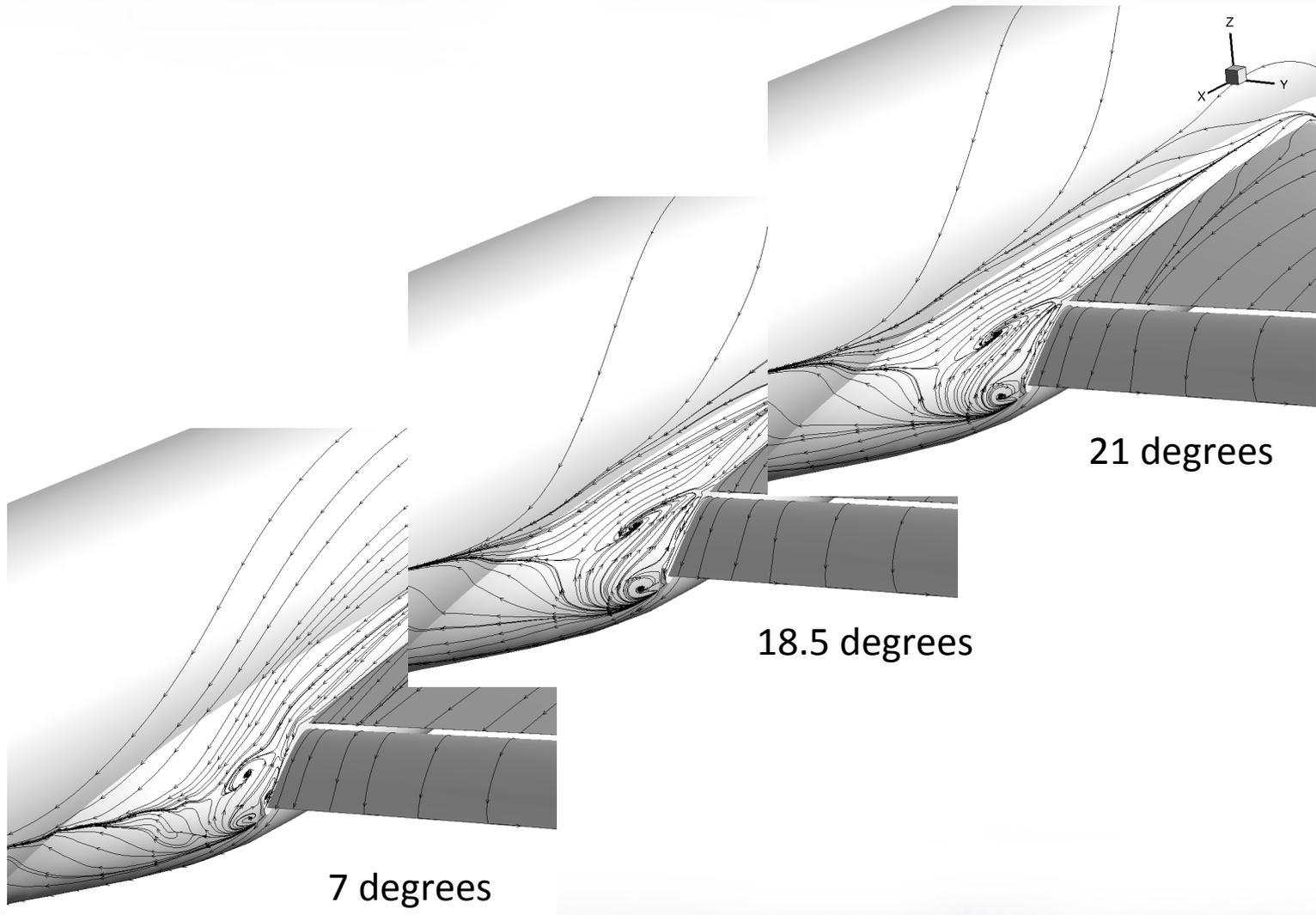
Case 1, Cp, Alpha = 21



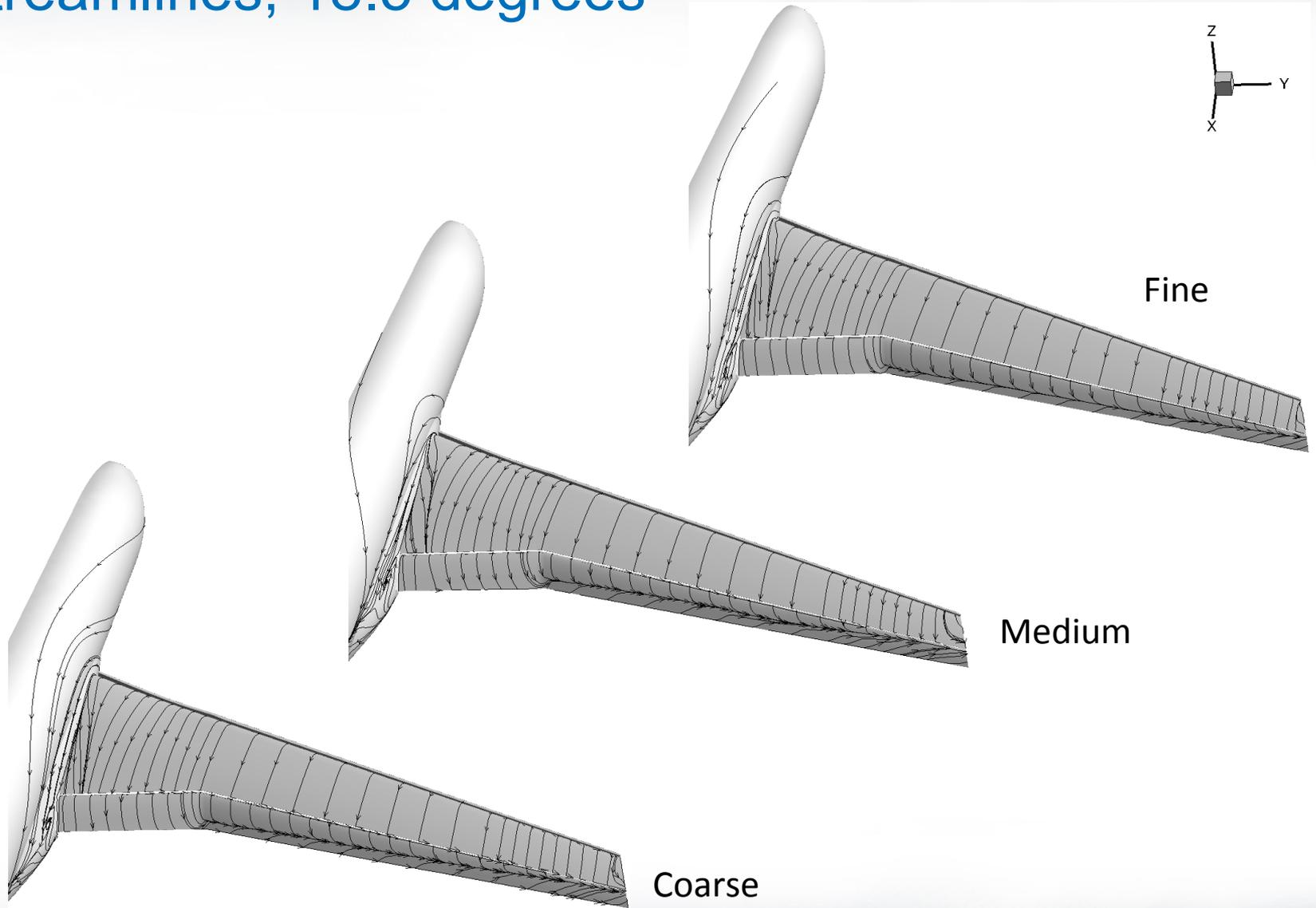
Streamlines, Medium Grid



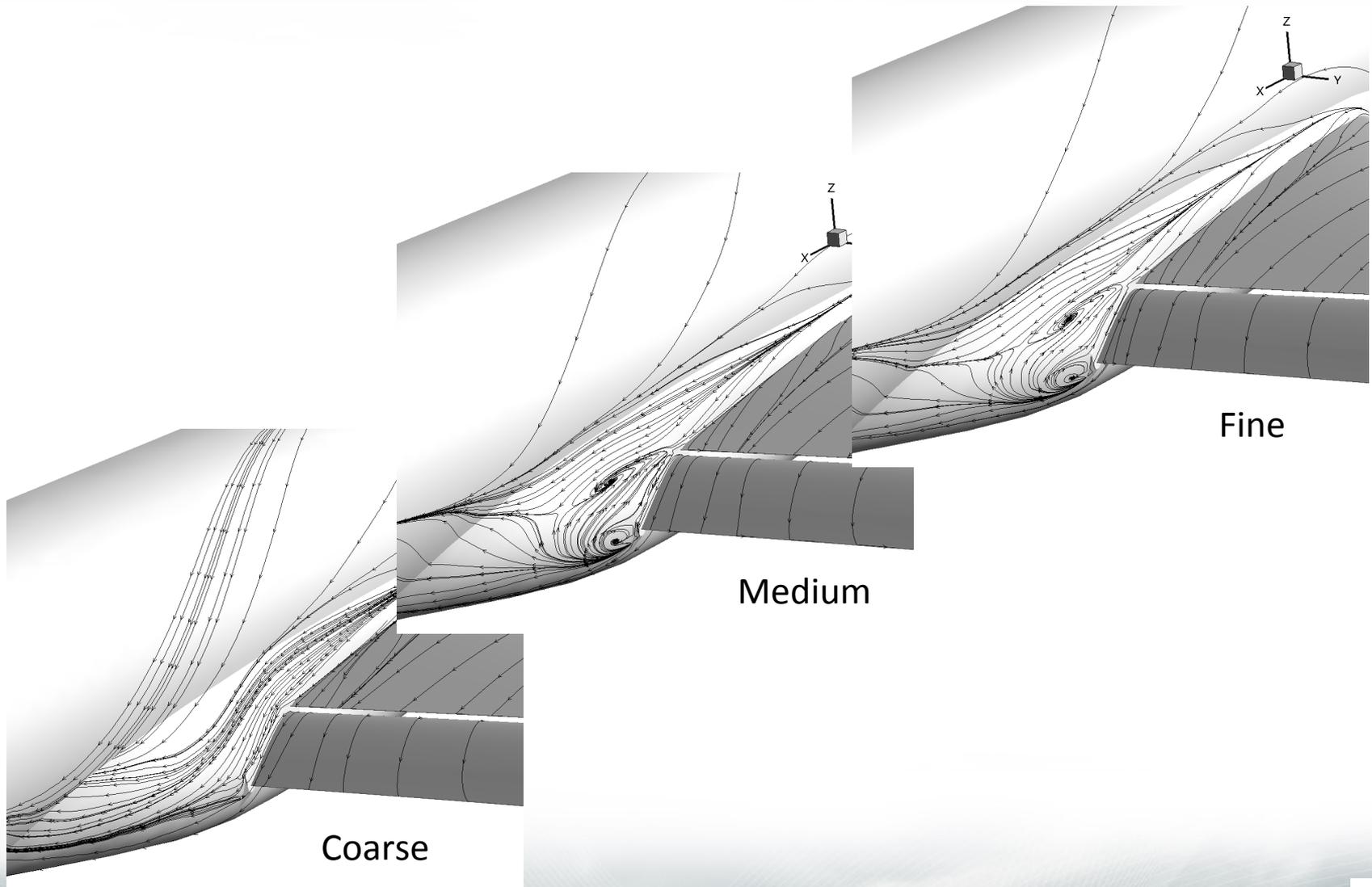
Medium Grid



Streamlines, 18.5 degrees



Streamlines, 18.5 degrees



Streamlines, 18.5 degrees

