

CFL3D Analysis of the Rectangular Supercritical Wing (RSW)

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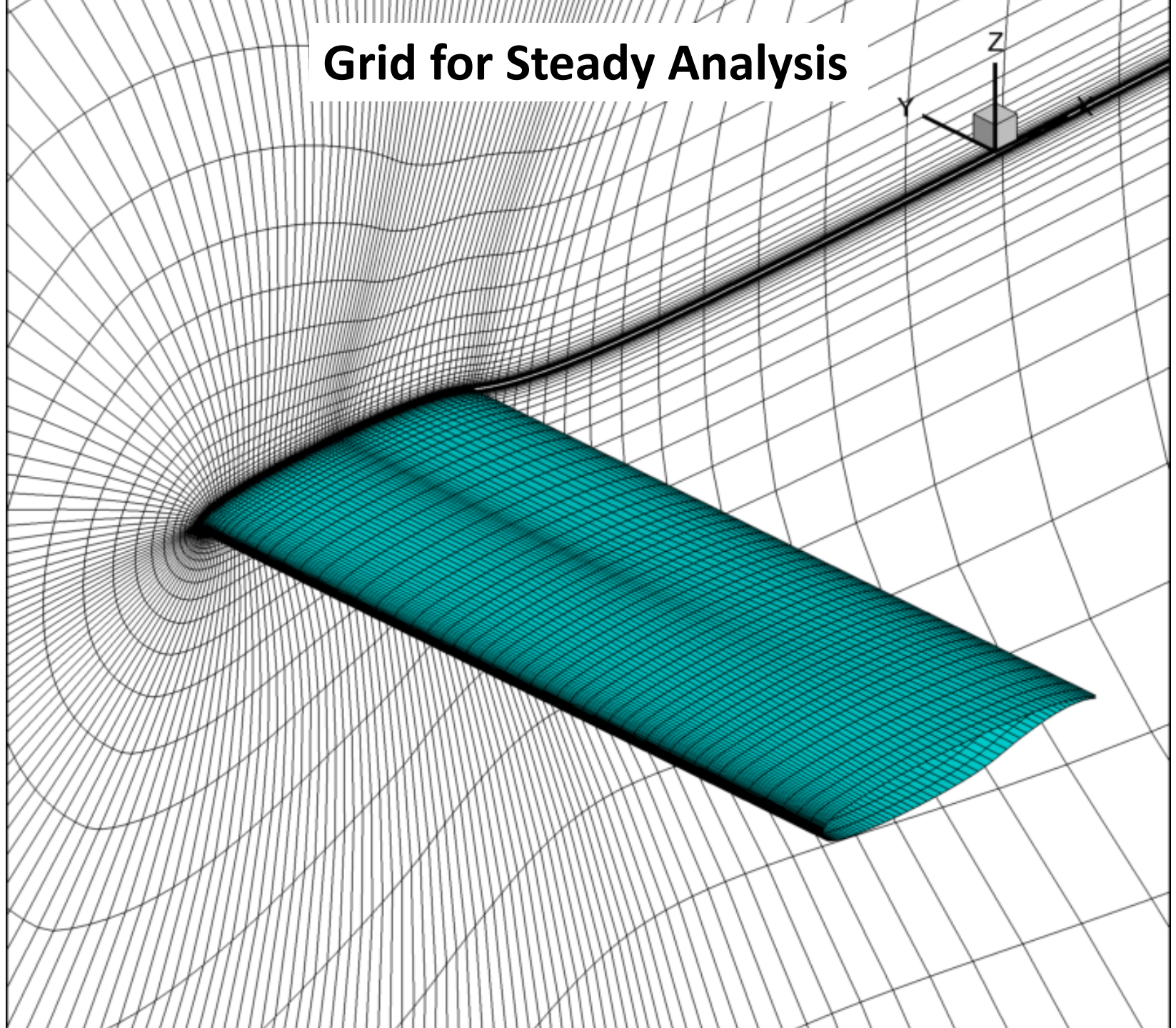
Analysis Summary

- CFL3D
 - Structured grid finite volume RANS/URANS Solver.
 - Spalart Allmaras turbulence model.
 - Local time-stepping for steady analysis.
 - Global time step with local time step subiteration for unsteady analysis.
 - Multigrid employed in steady analysis and unsteady subiterations.
- Geometry modeling and Grid Generation.
 - Single-block C-H grid generated using an internal batch-mode grid generation tool.
 - Coarse, medium, and fine grids generated for grid convergence studies on $\alpha = 2.0^\circ$ steady case.
 - No grid convergence conducted for unsteady cases.
 - Temporal convergence investigated for unsteady cases.
 - 200, 400, and 800 time steps per cycle, each with 4 subiterations.

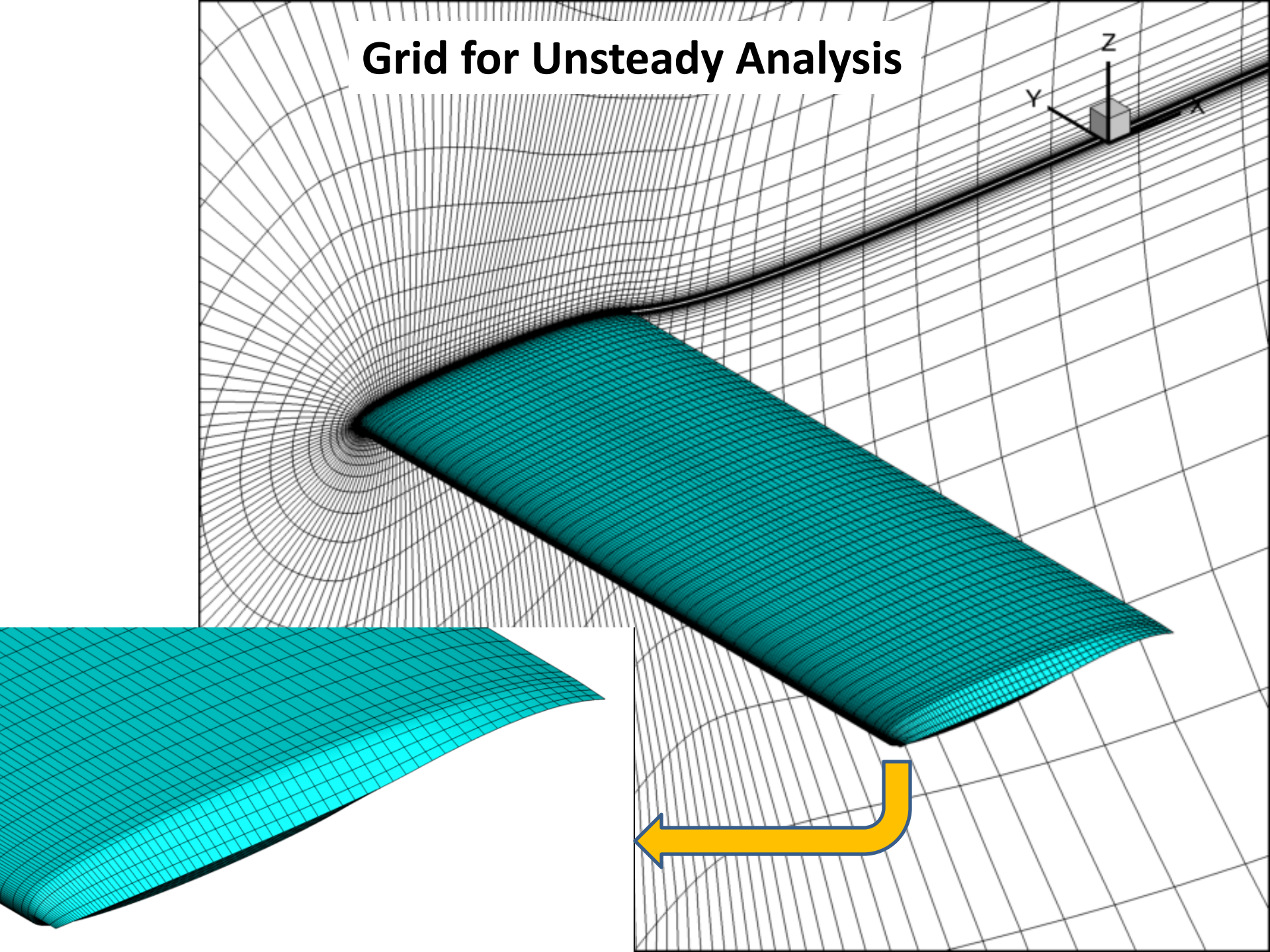
Geometry Analysis and grid Generation Details

- Wing extended to TDT wind tunnel wall (55 in. span).
 - No splitter plate model.
- Grids clustered to resolve BL on both the wing surface and wind tunnel wall ($y^+ < 1.0$).
- Wing tip scarfed rather than rounded.
- Steady grids:
 - Coarse – $113 \times 49 \times 33 = 182,721$ pts.
 - Medium – $225 \times 97 \times 65 = 1,418,625$ pts.
 - Fine – $449 \times 193 \times 129 = 11,178,753$ pts.
- Unsteady grid:
 - Same grid size as medium grid, but surface point distribution modified to accommodate CFL3D's moving grid algorithm.
 - Modified scarfed wing tip model.

Grid for Steady Analysis

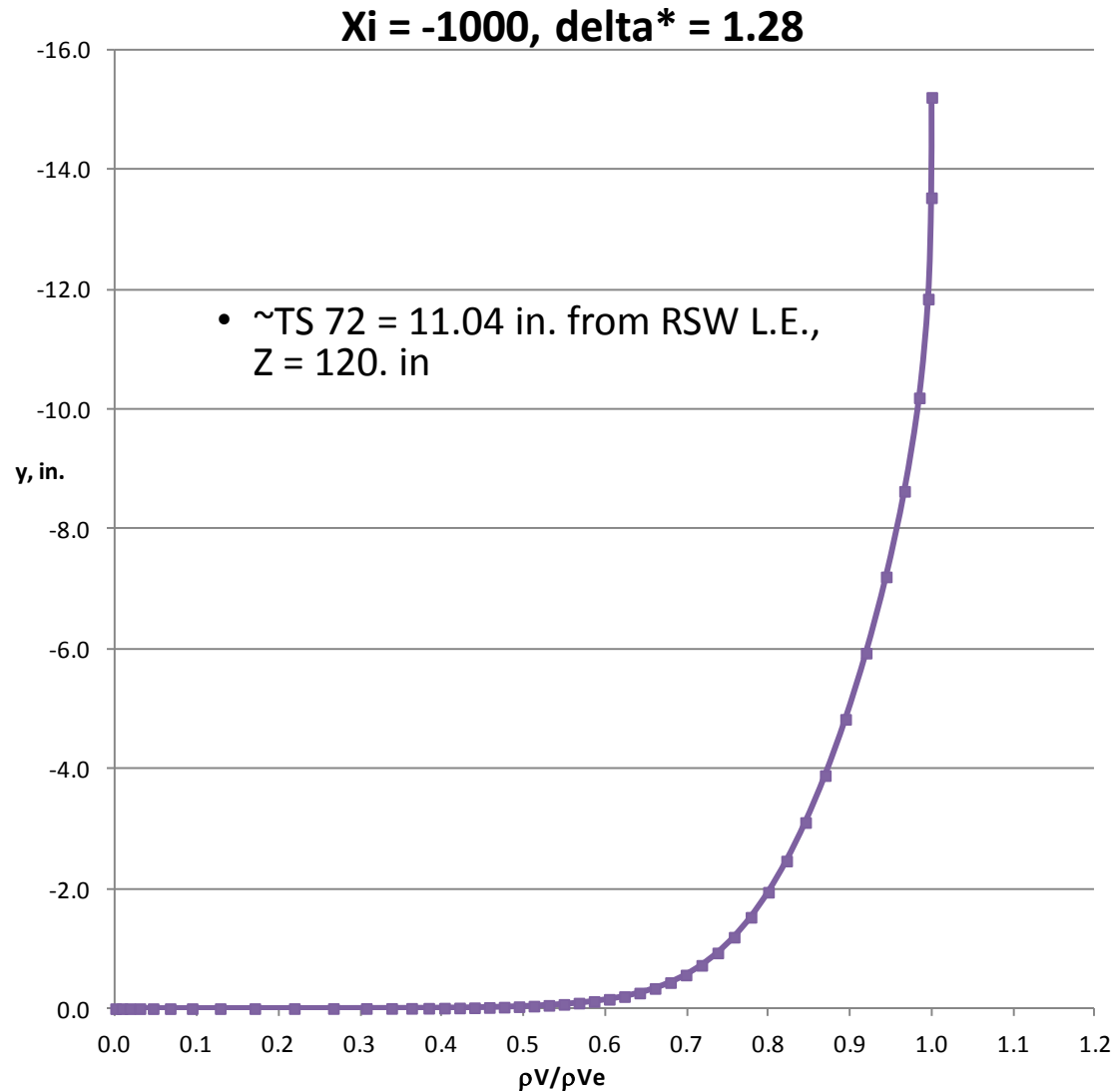


Grid for Unsteady Analysis



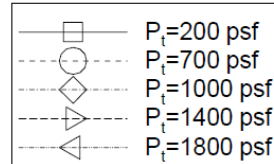
CFL3D TDT Tunnel Wall BL

RSW, $M = 0.825$, $\alpha = 2.0^\circ$

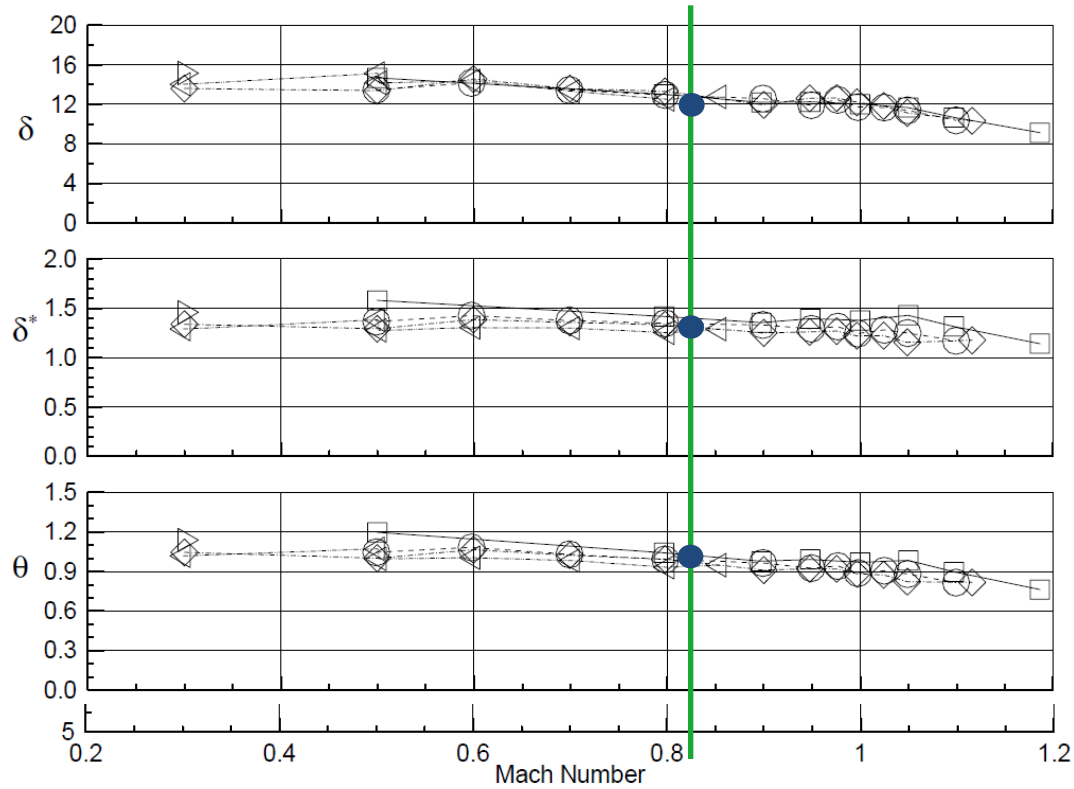


TDT East Wall Boundary Layer

- Wieseman, C. D. and Bennett, R. M., "Wall Boundary Layer Measurements for the NASA Langley Transonic Dynamics Tunnel," NASA/TM-2007-214867, April, 2007



● CFL3D, $M = 0.825$, $\alpha = 2.00^\circ$,
 $X_i = -1000$ in.

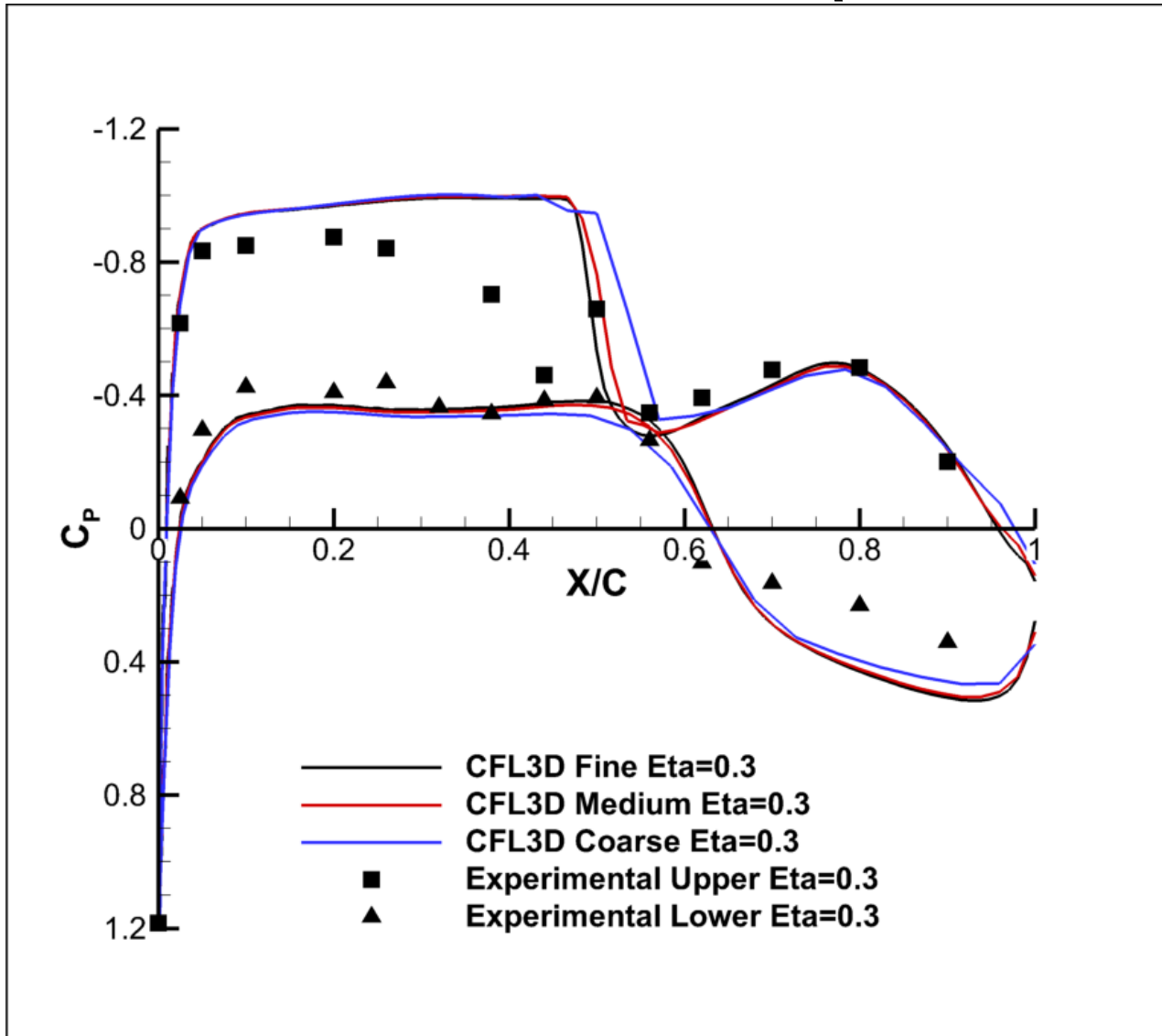


a) East wall rake

Figure 17. Boundary layer parameters for R-134a, all slots open, TS 72, standard flap settings.

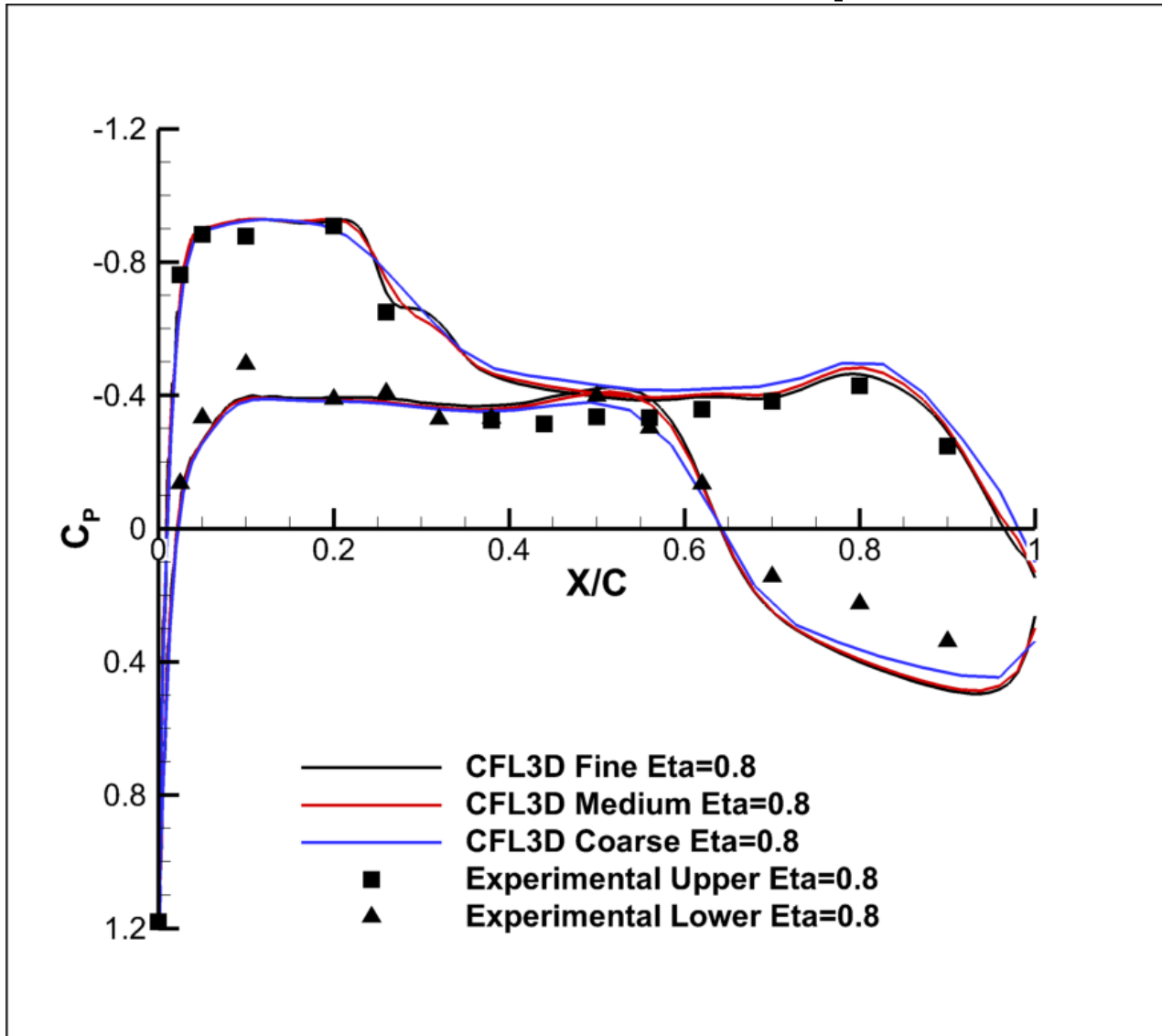
Steady RSW CFL3D Analysis

$M=0.825$ $\alpha=2.00$ $\eta=.309$



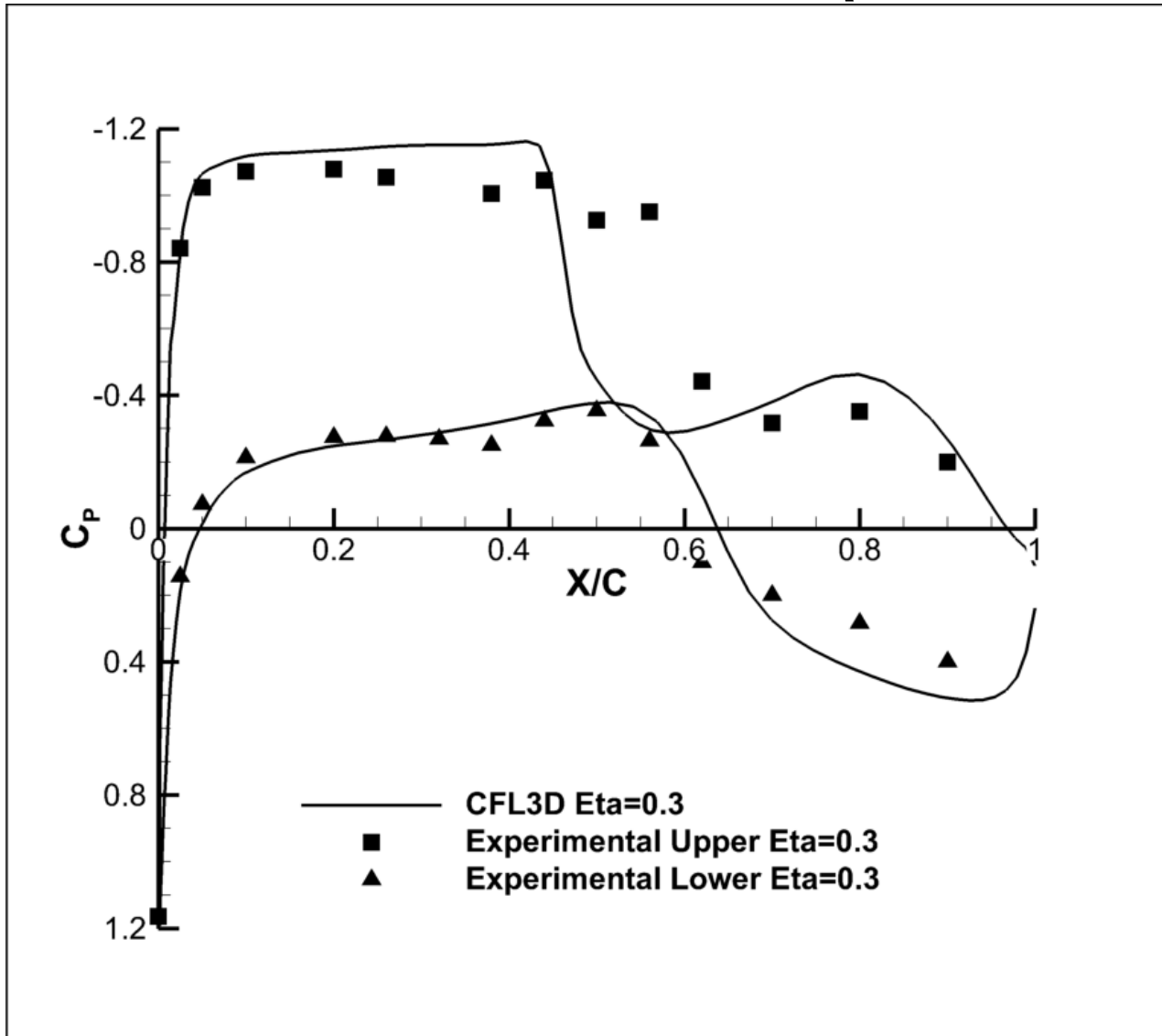
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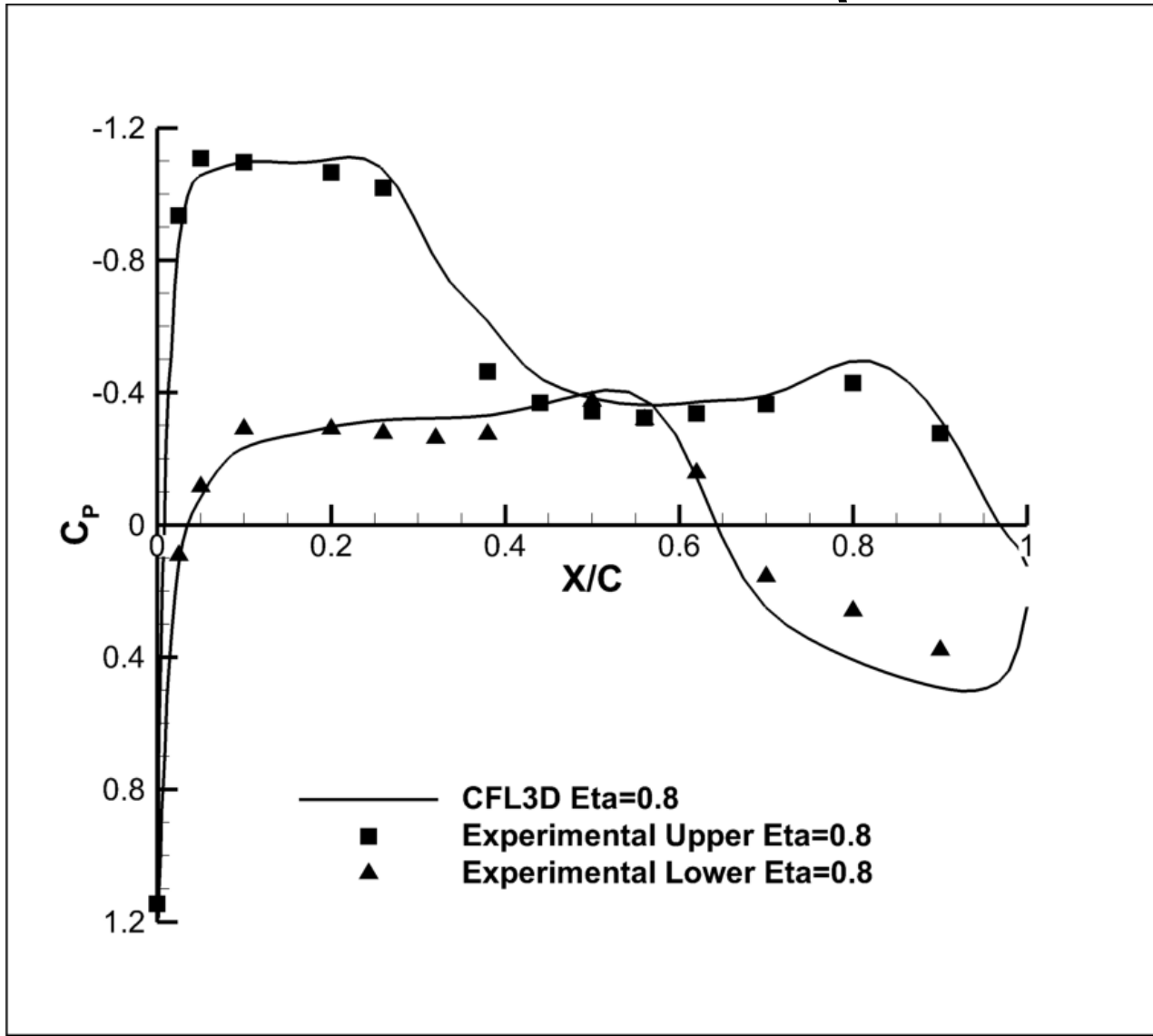
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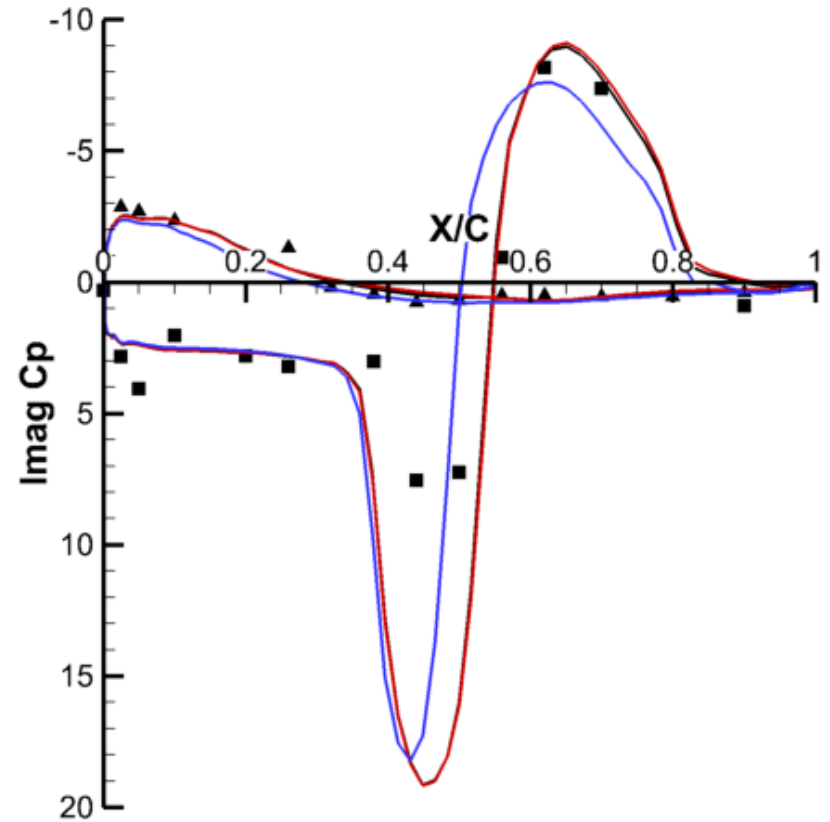
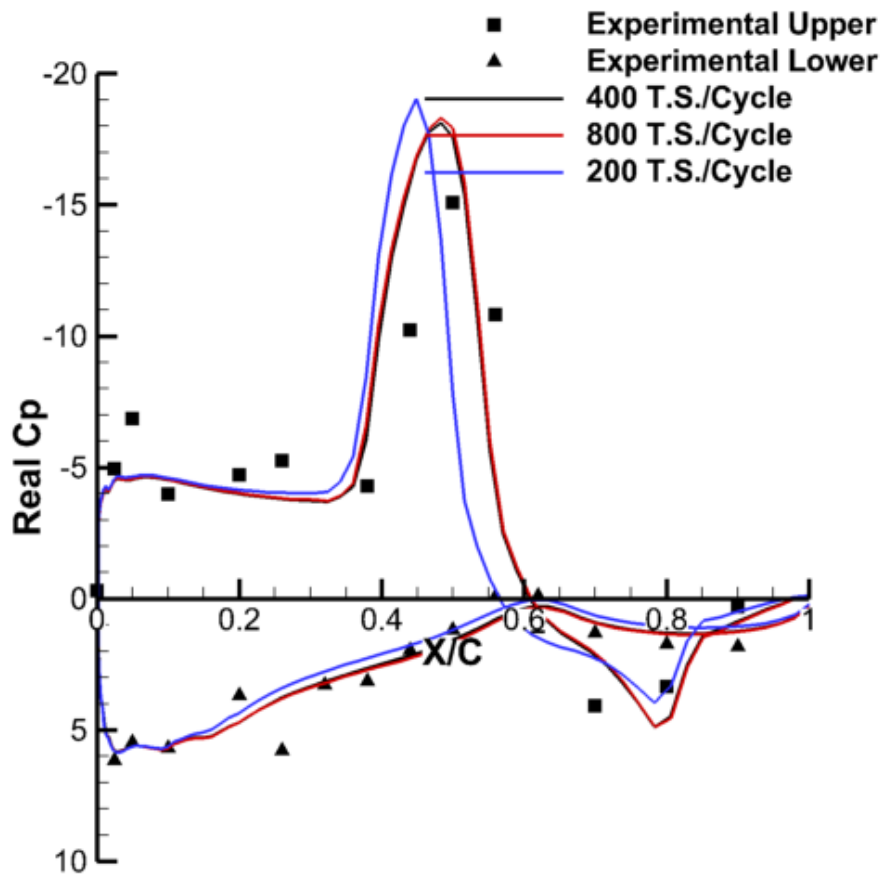
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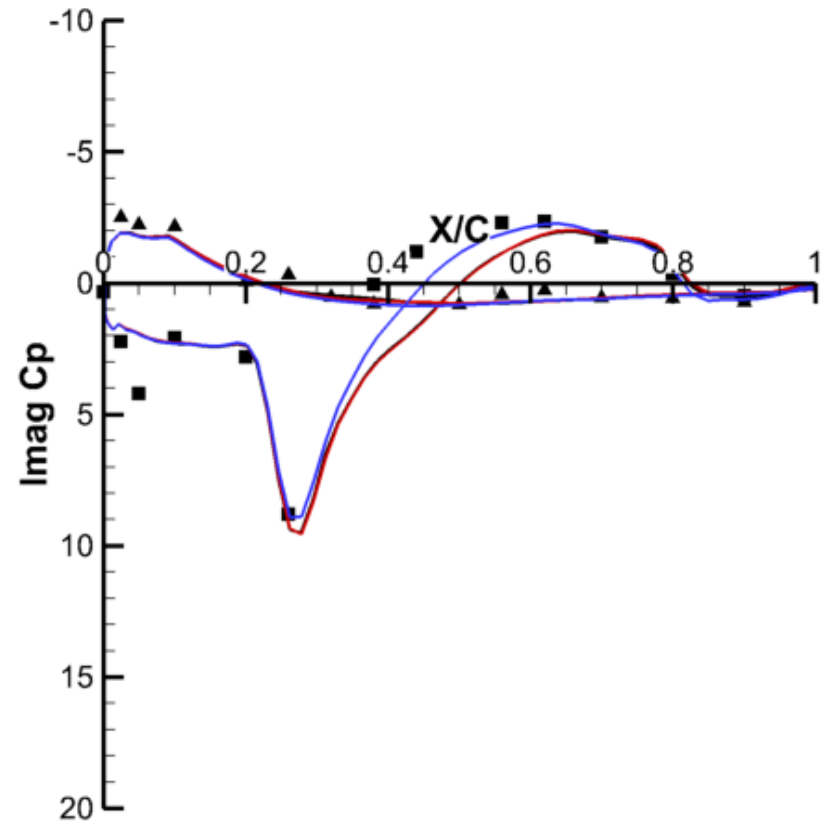
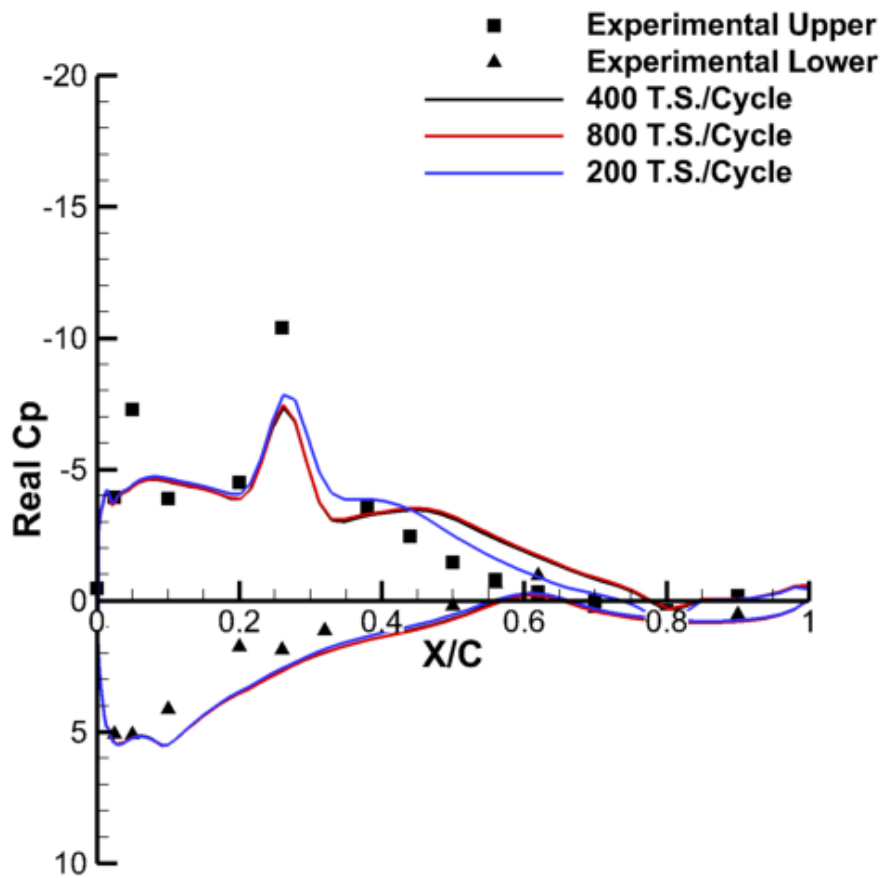
Unsteady RSW CFL3D Analysis

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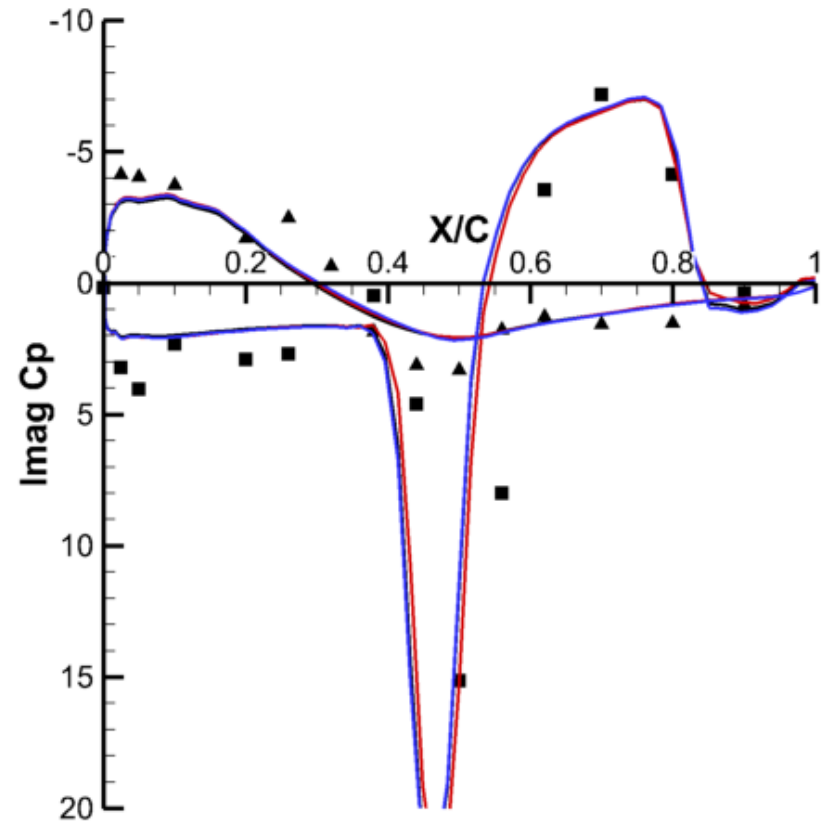
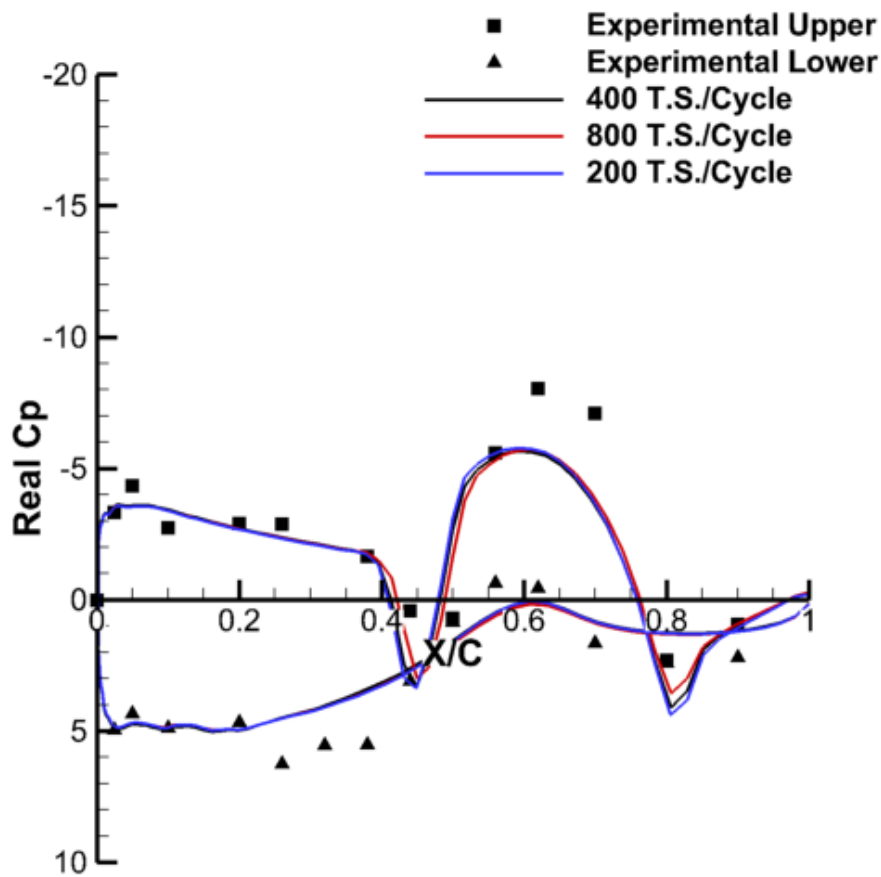
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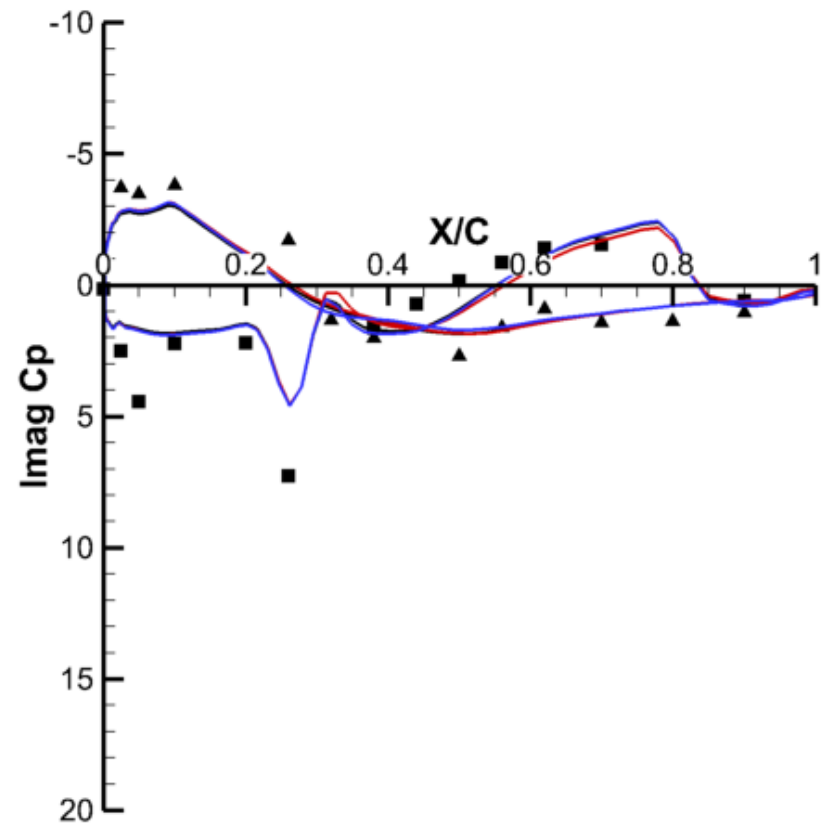
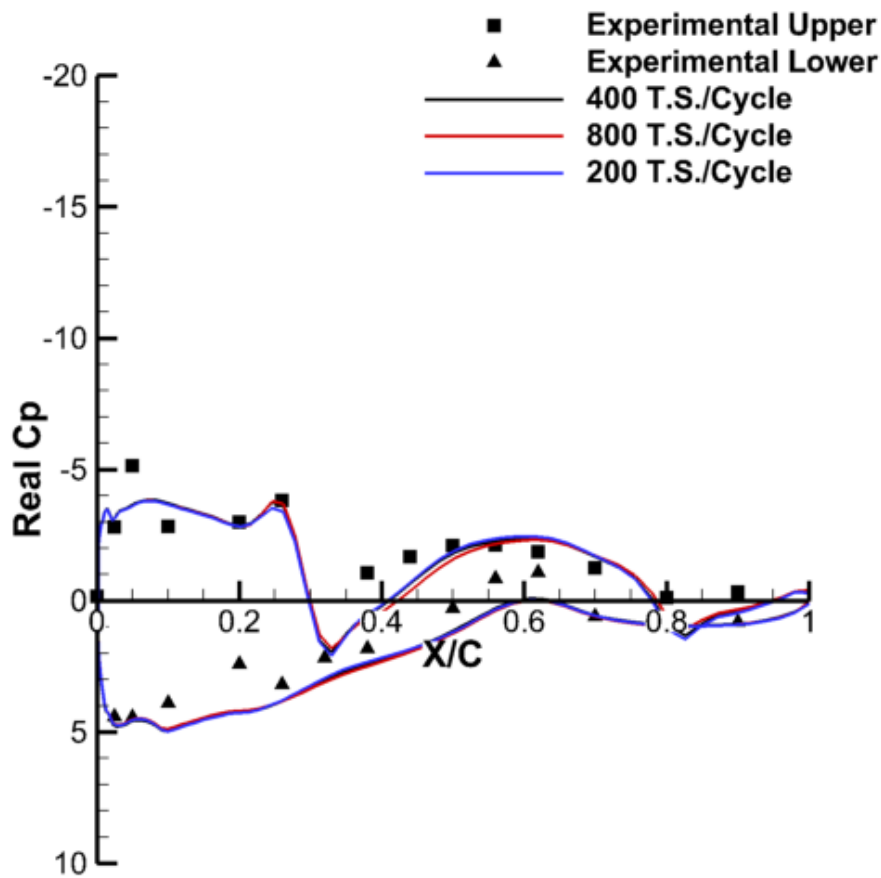
Unsteady RSW CFL3D Analysis

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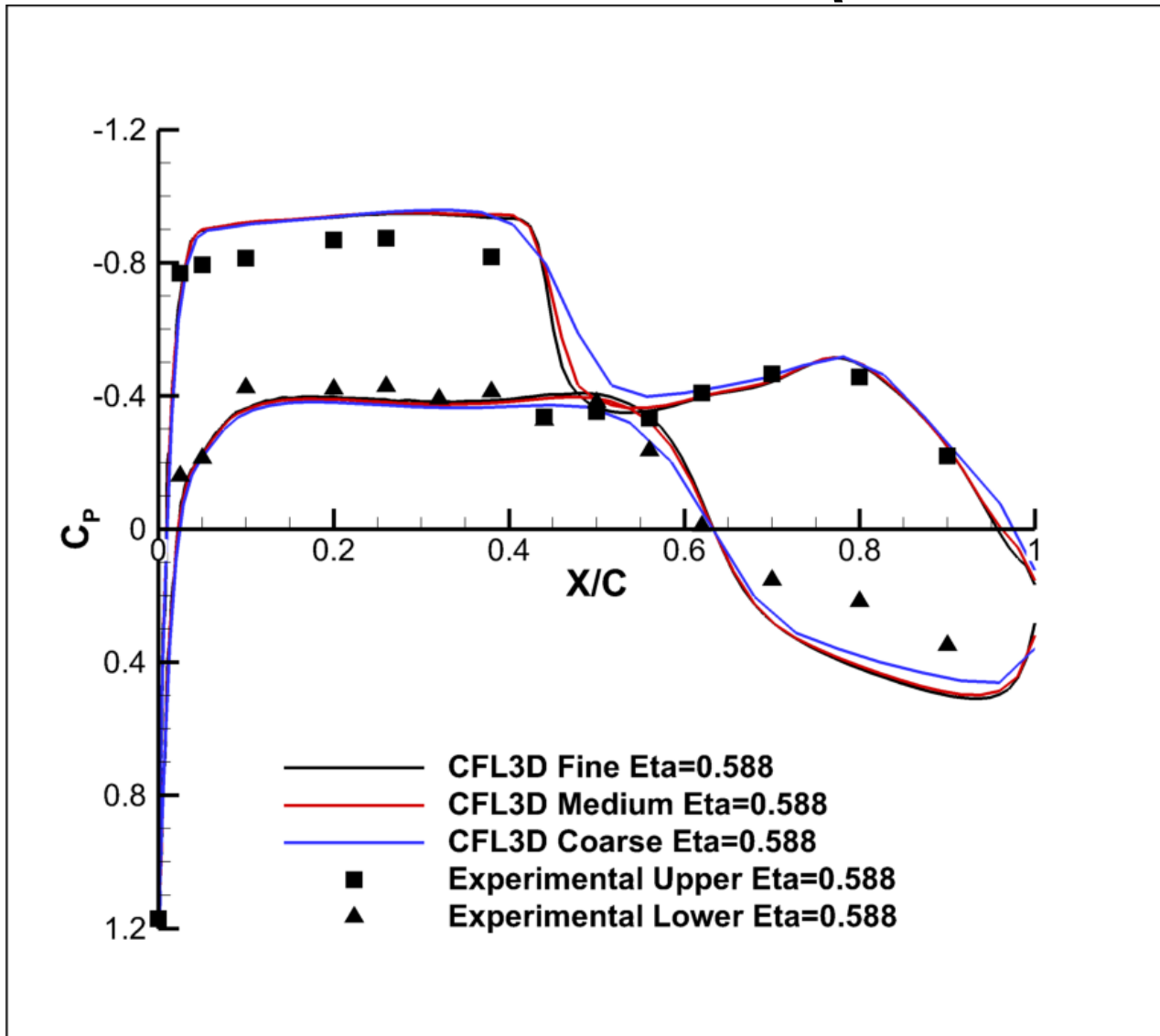
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BACKUP

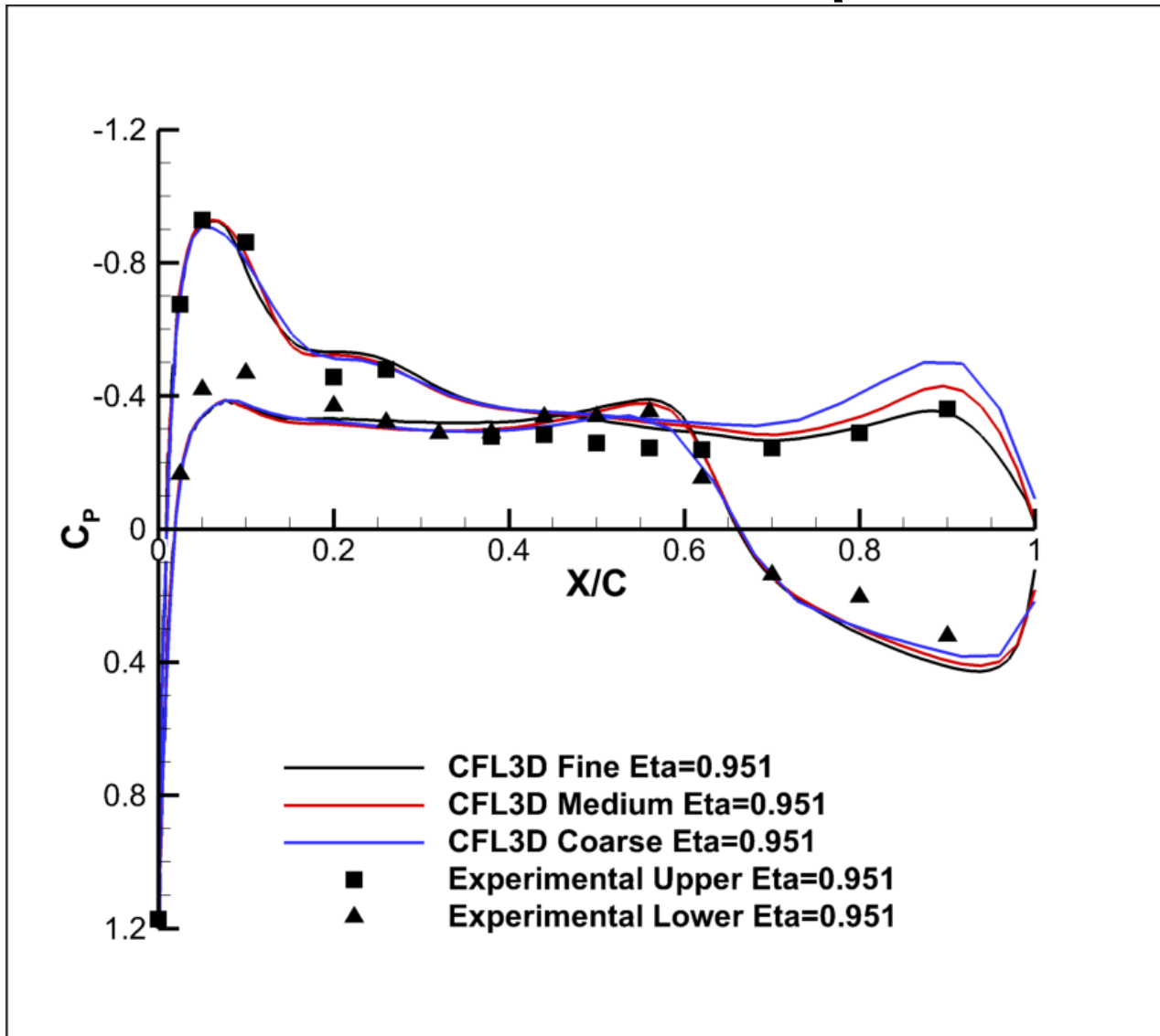
Steady RSW CFL3D Analysis

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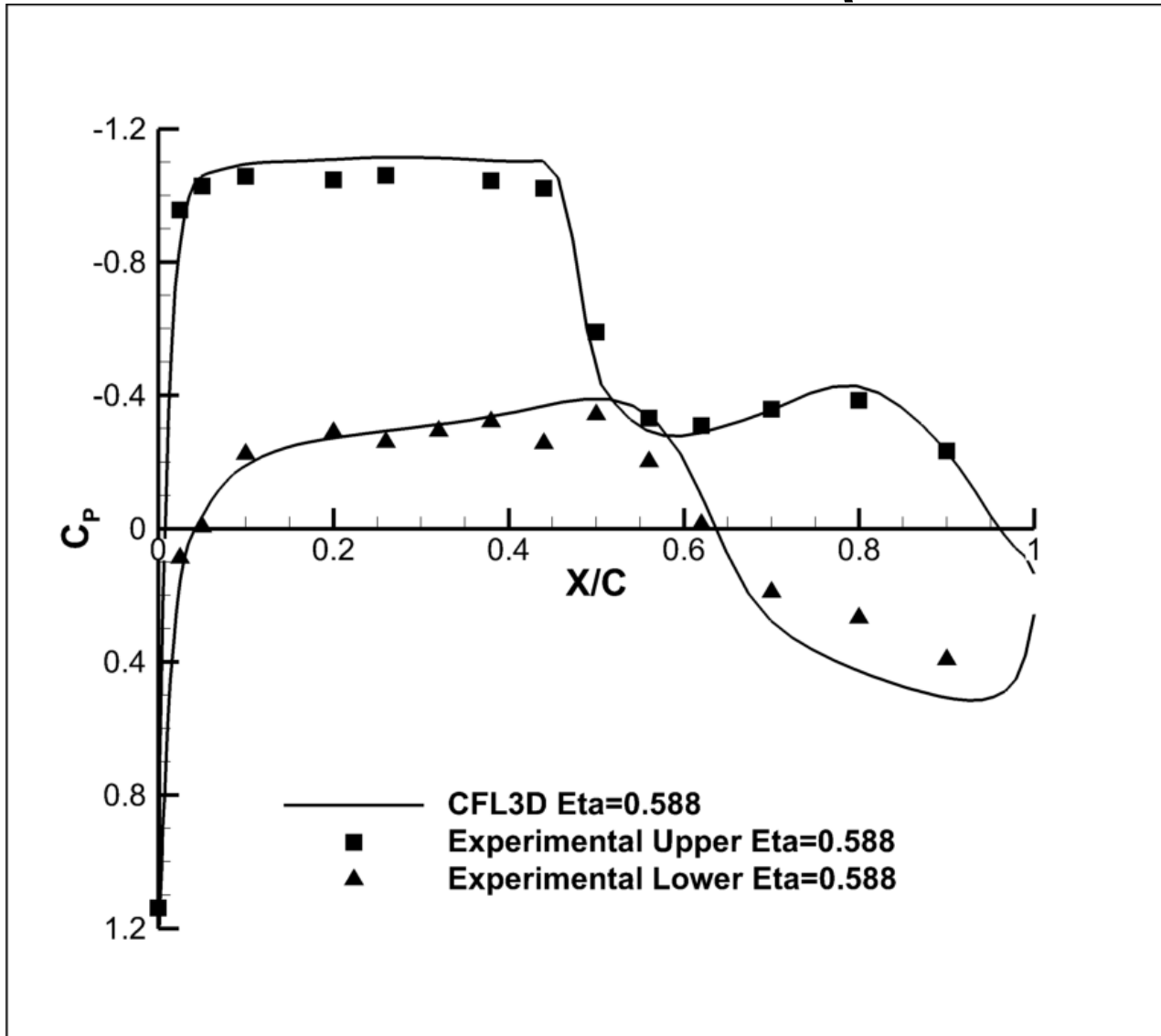
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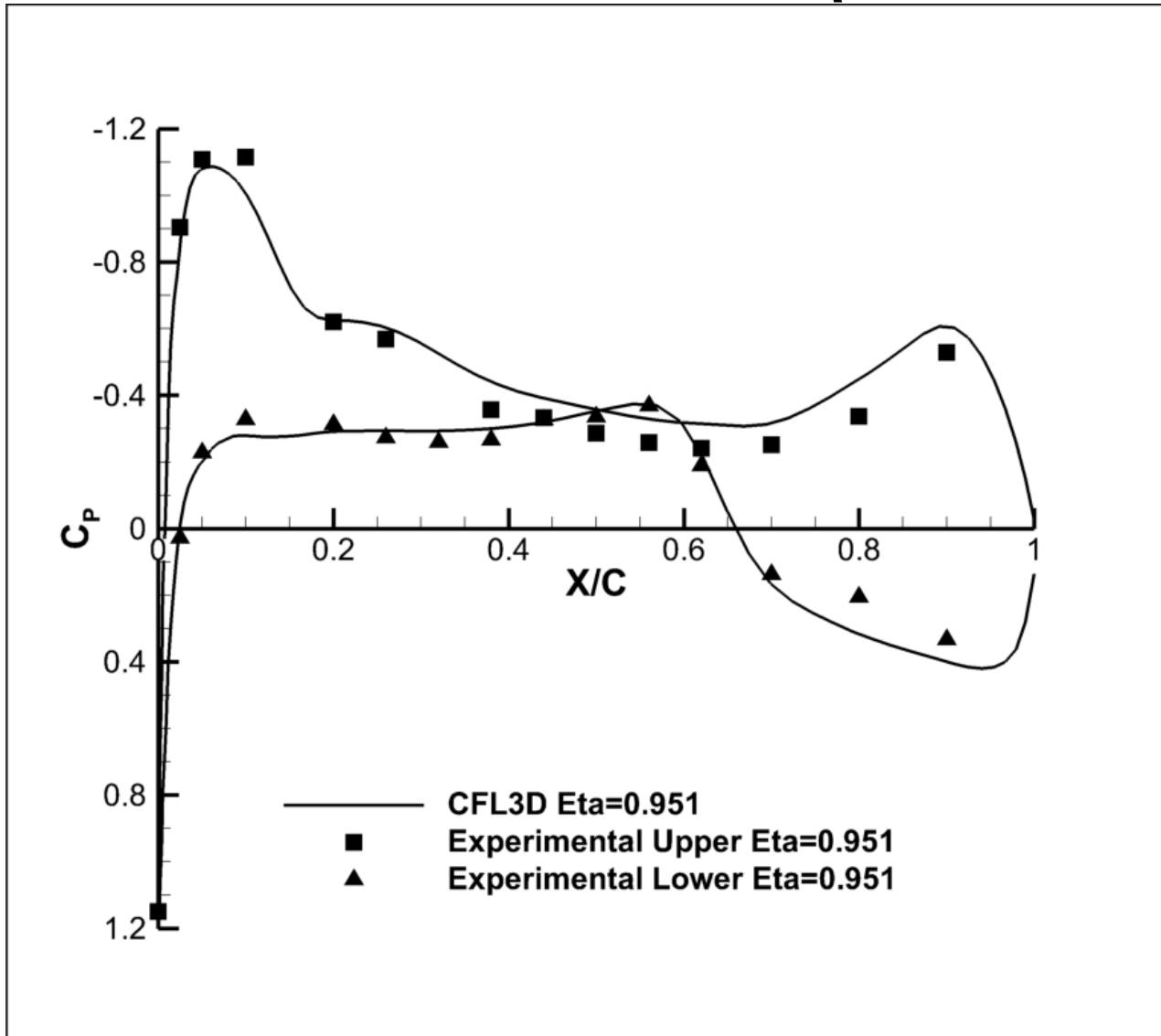
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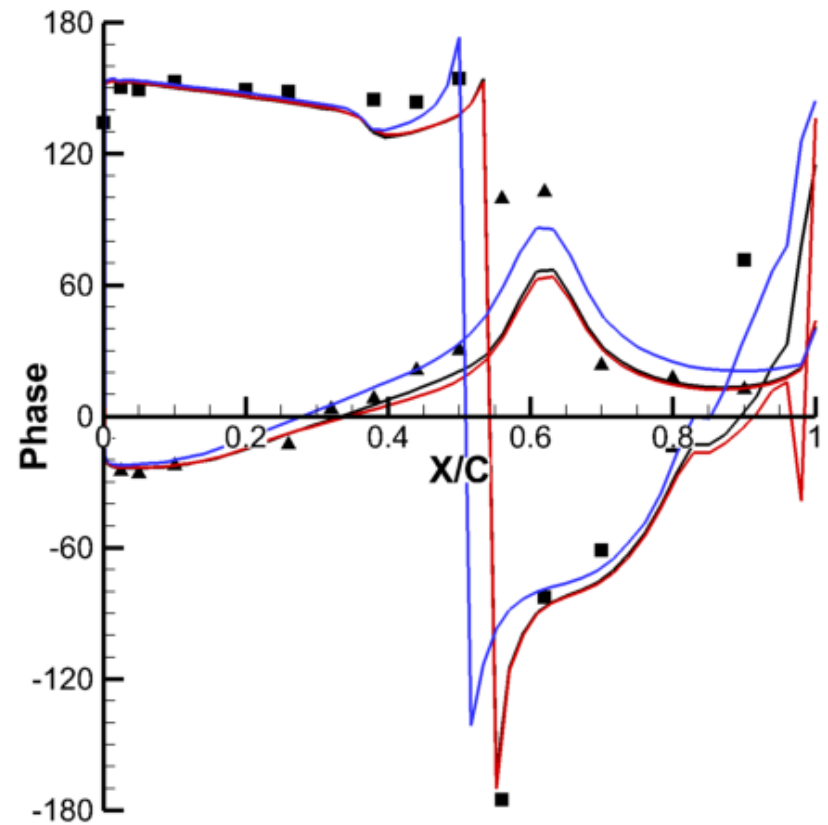
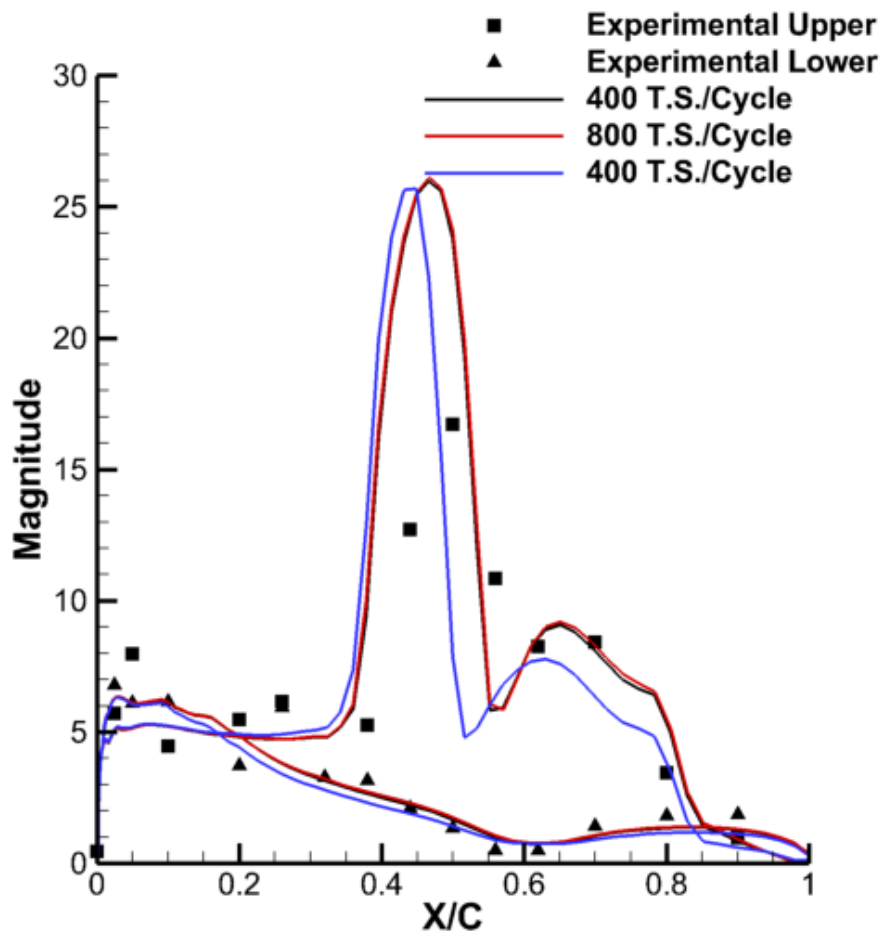
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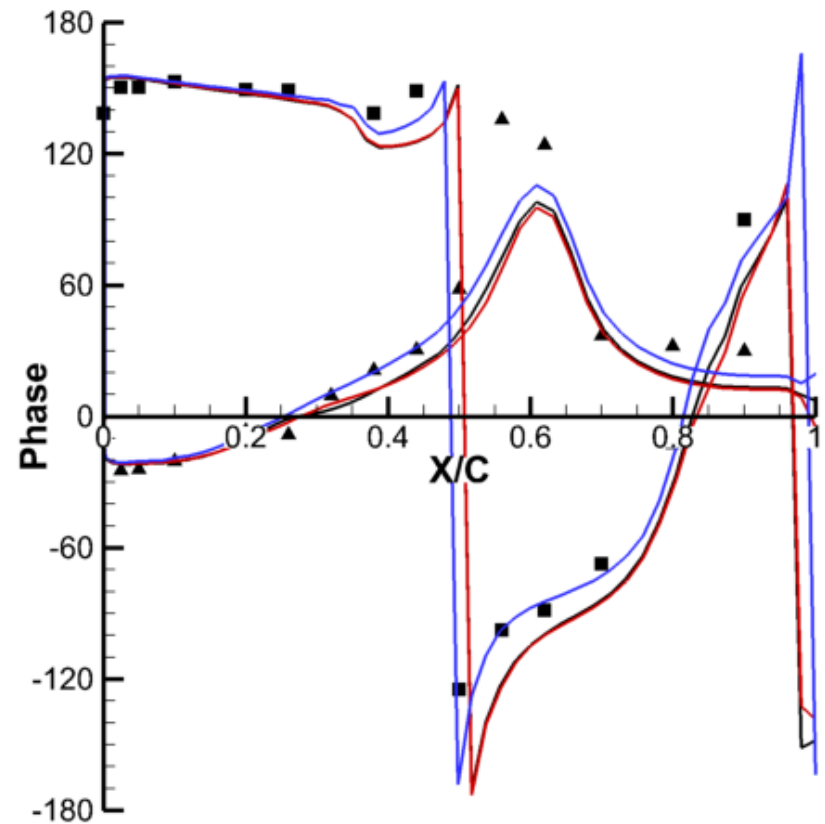
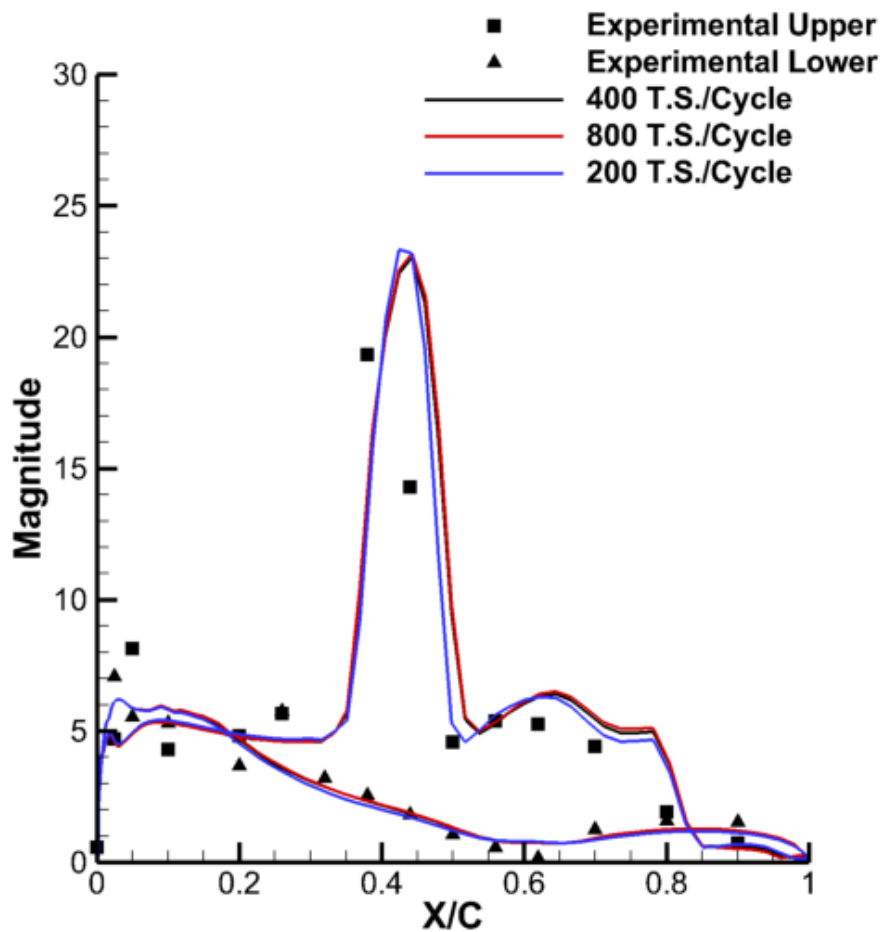
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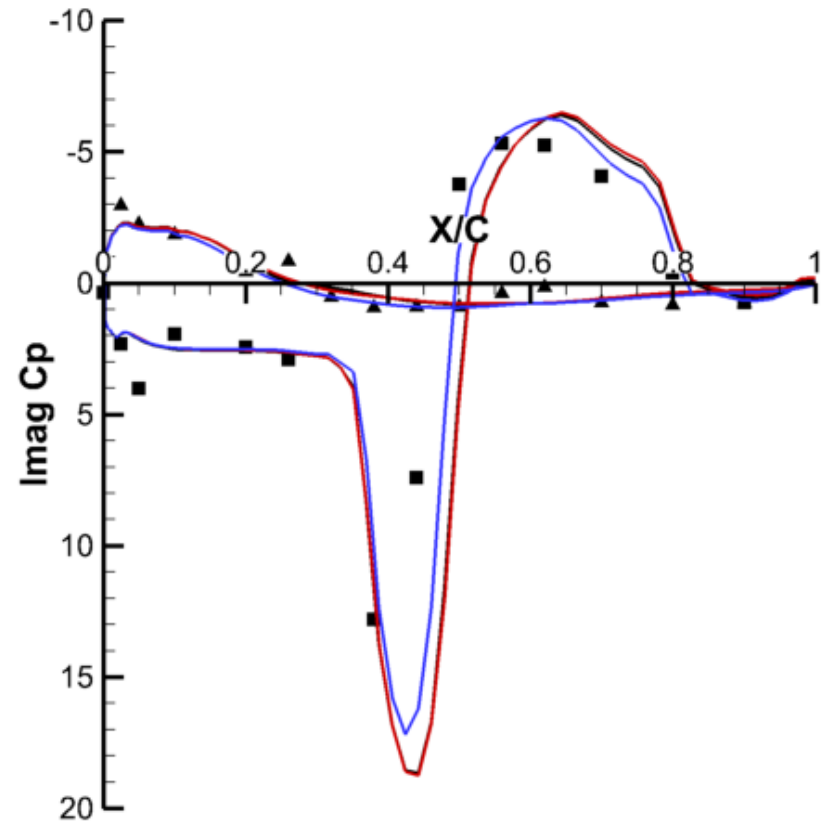
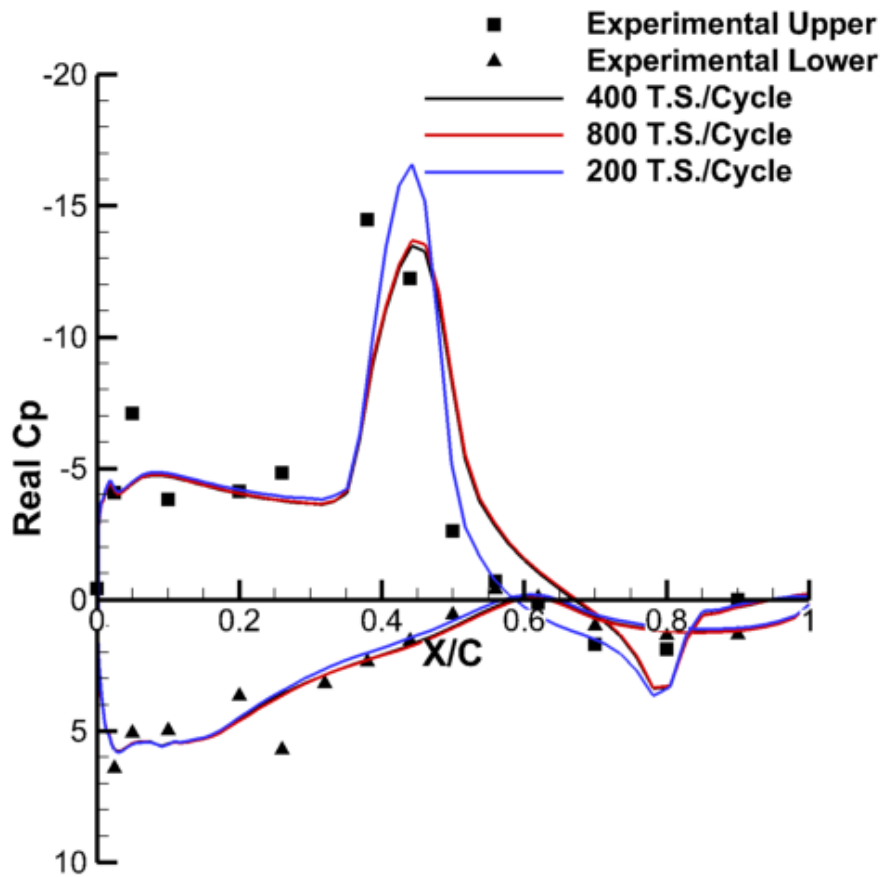
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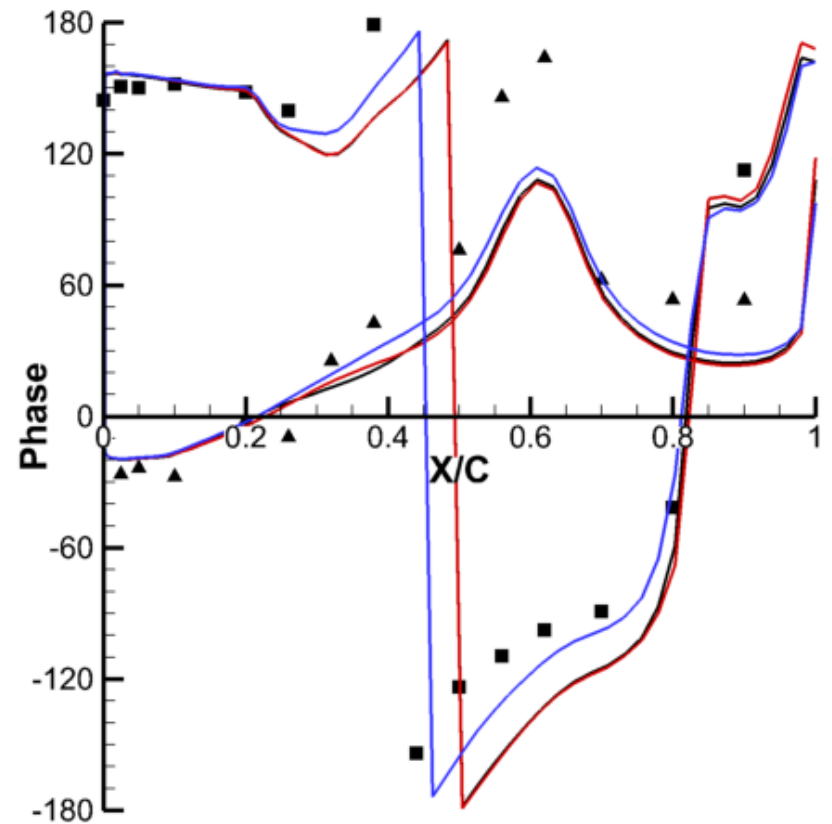
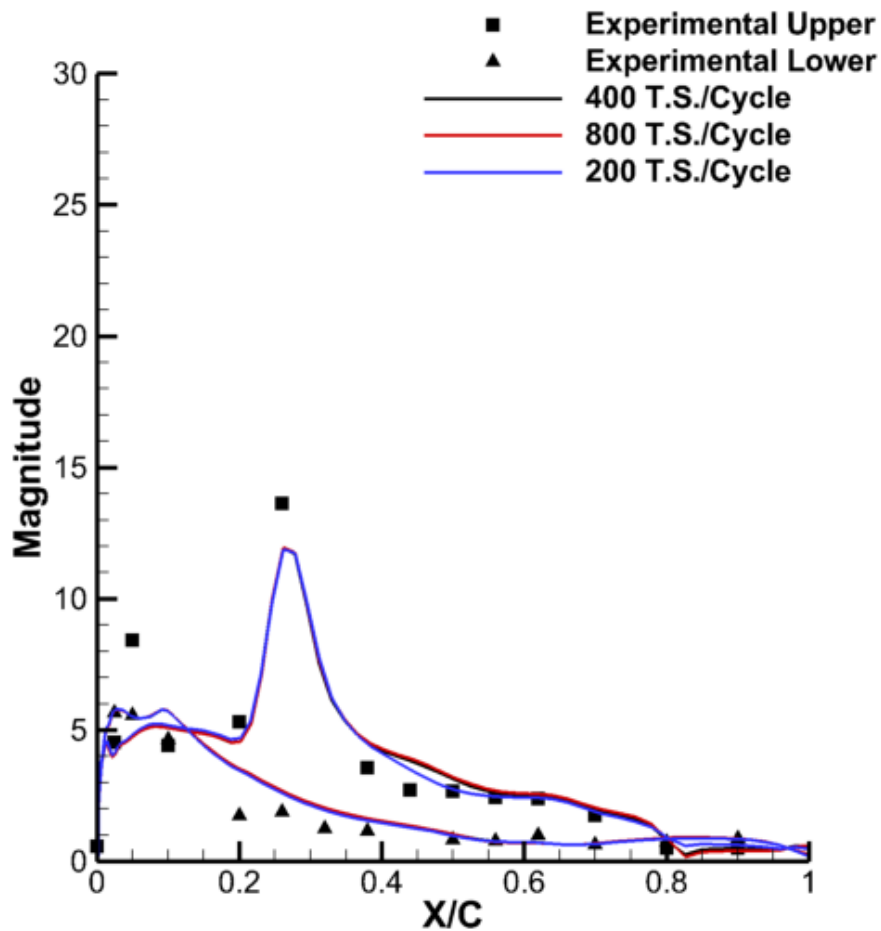
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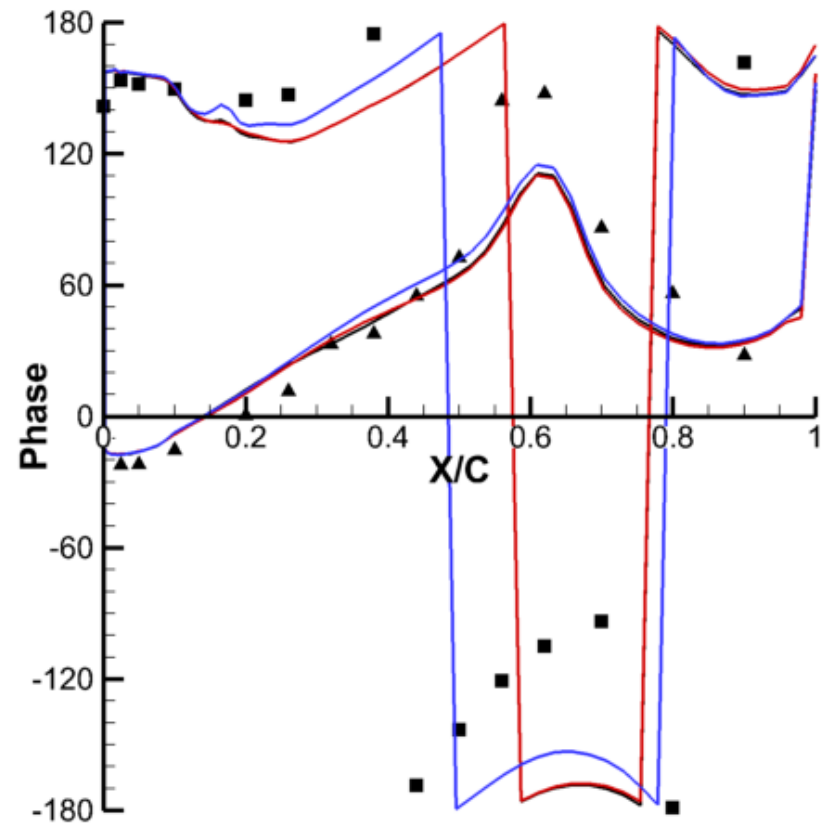
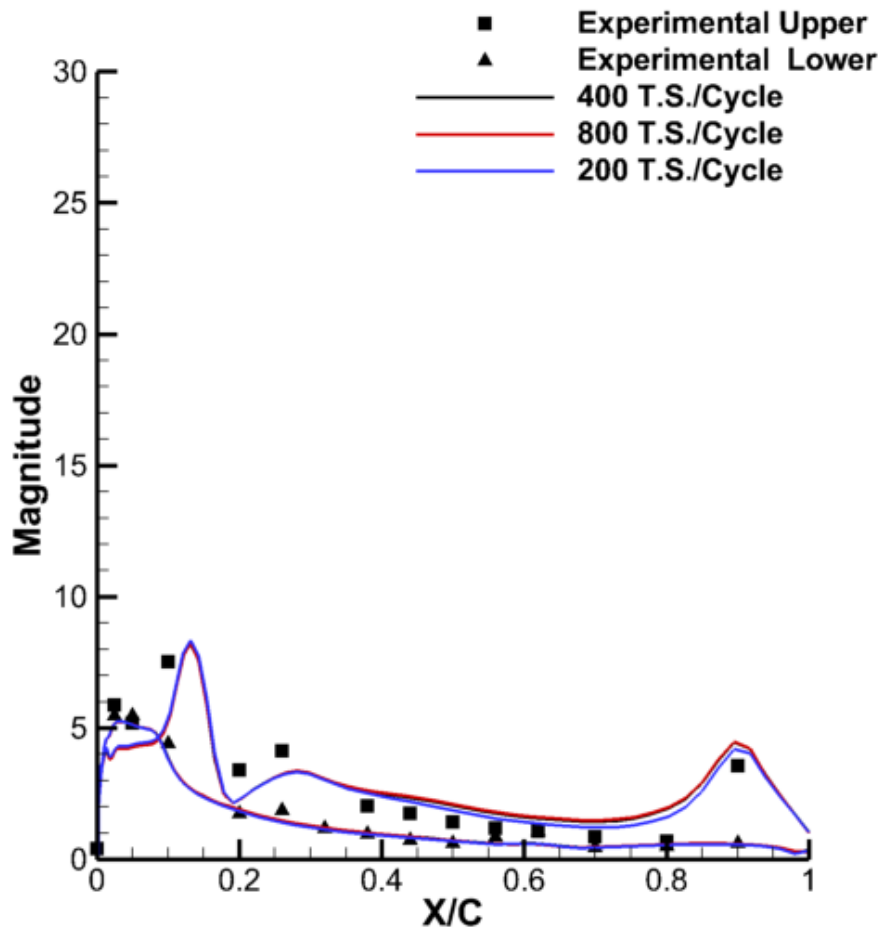
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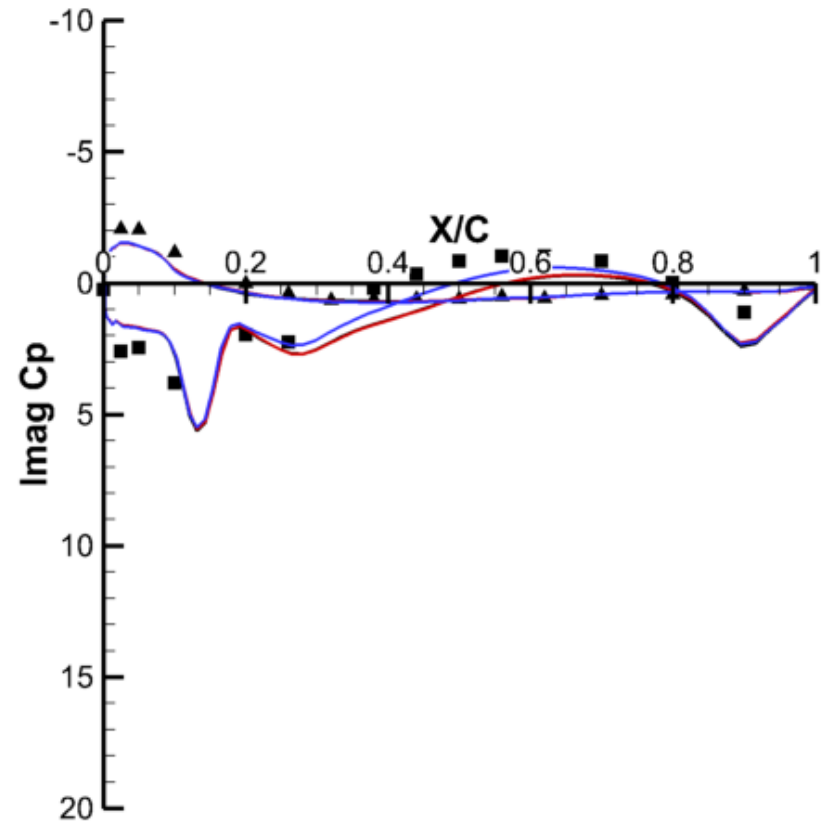
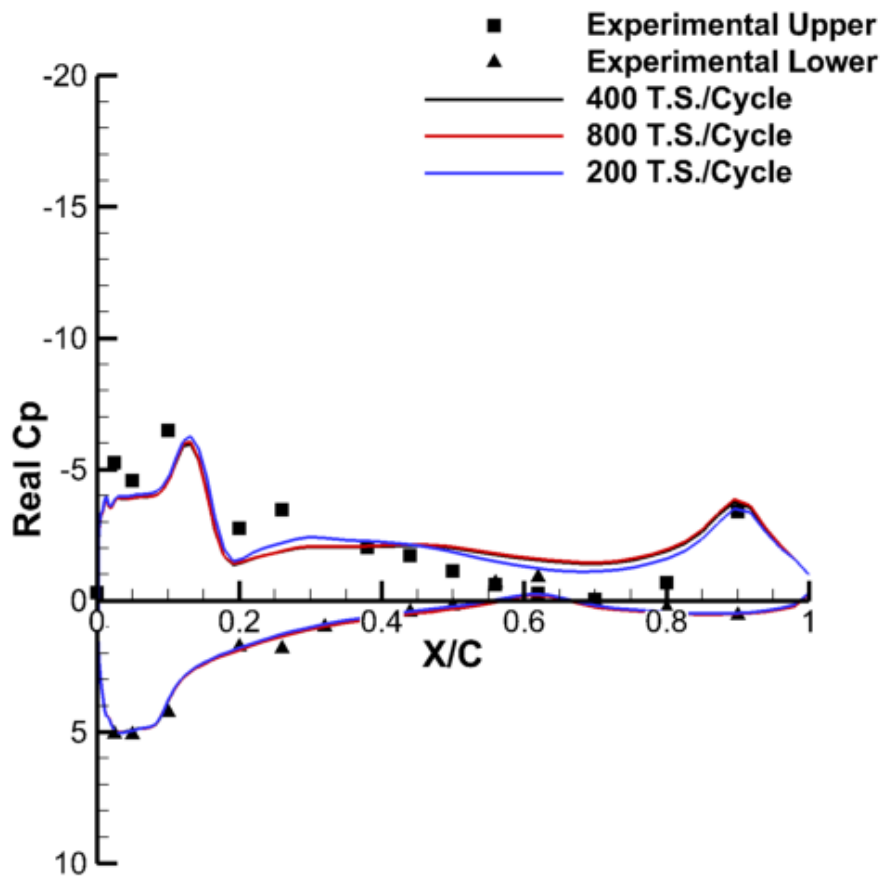
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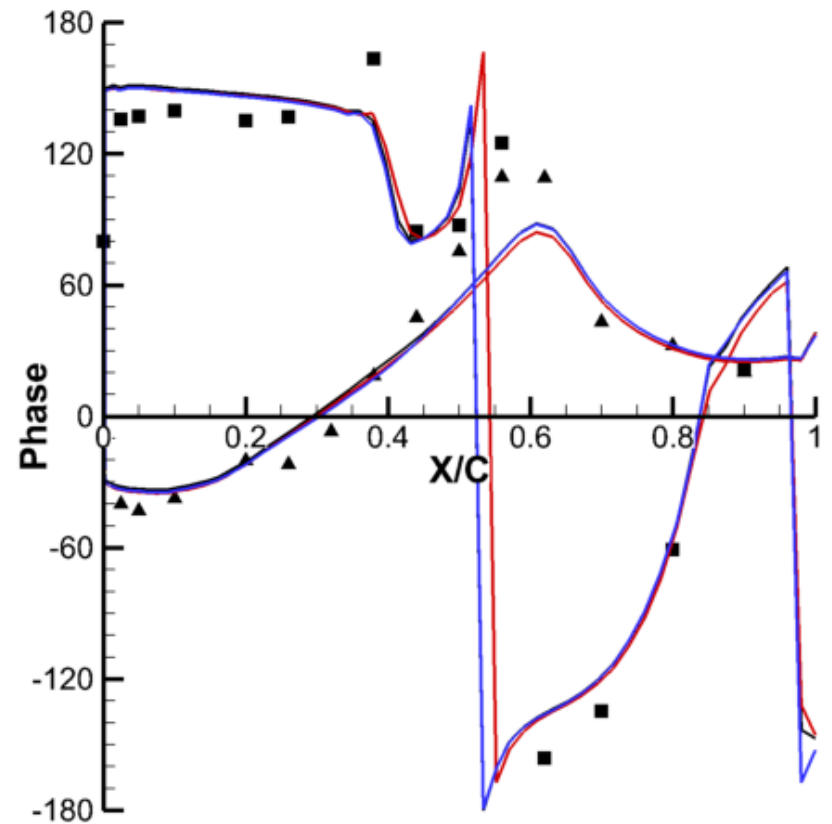
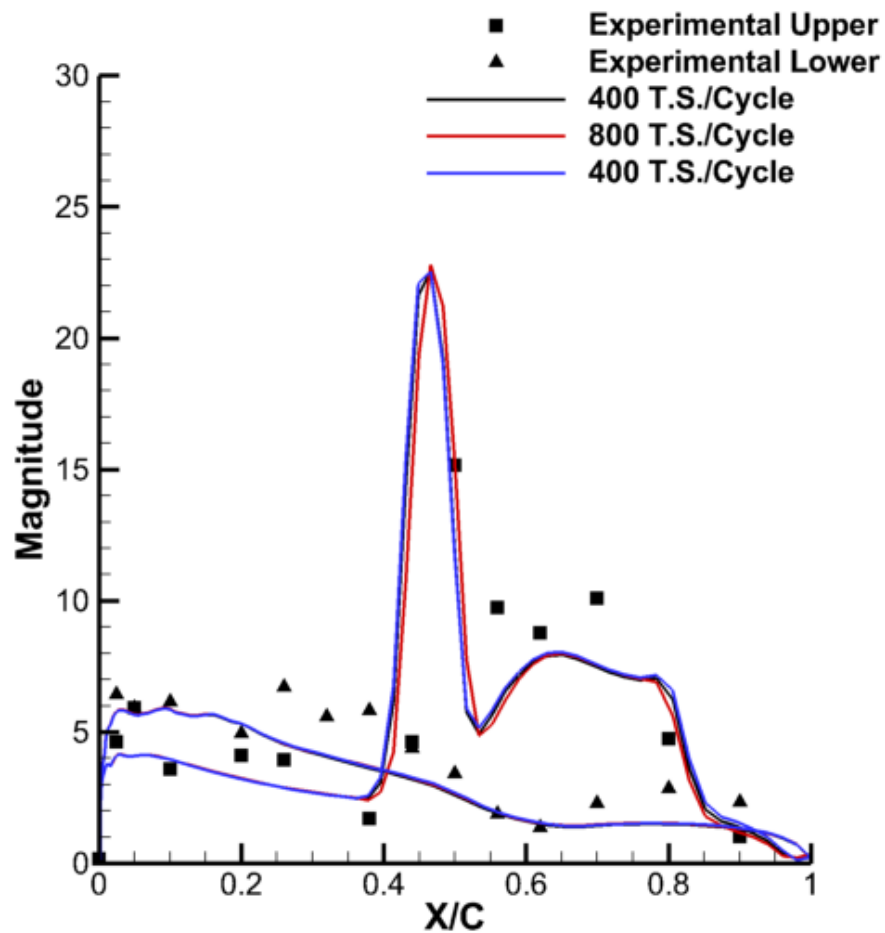
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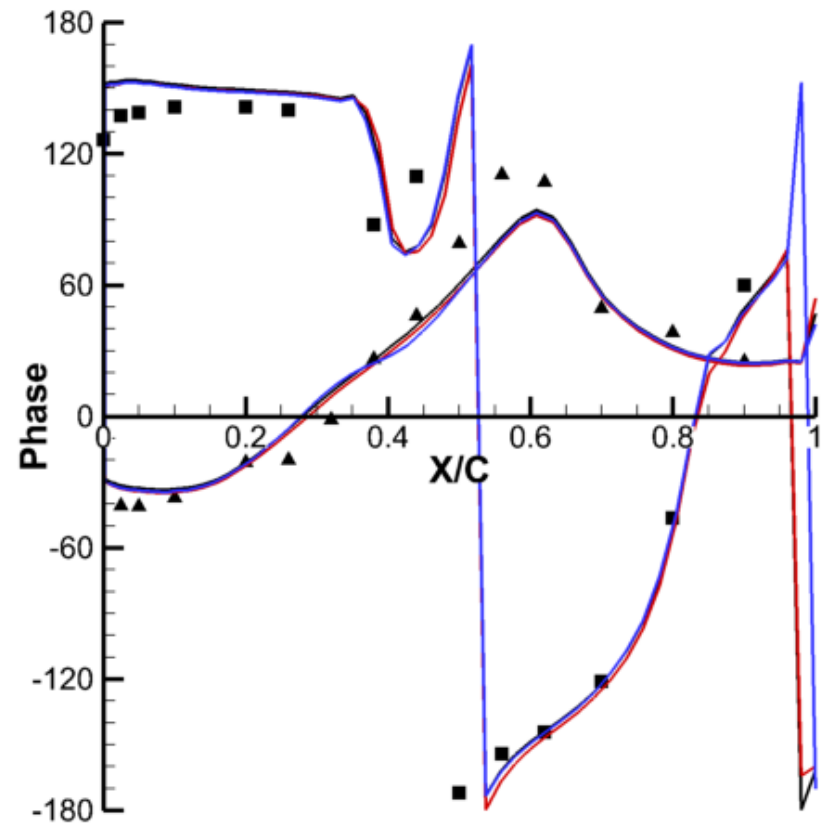
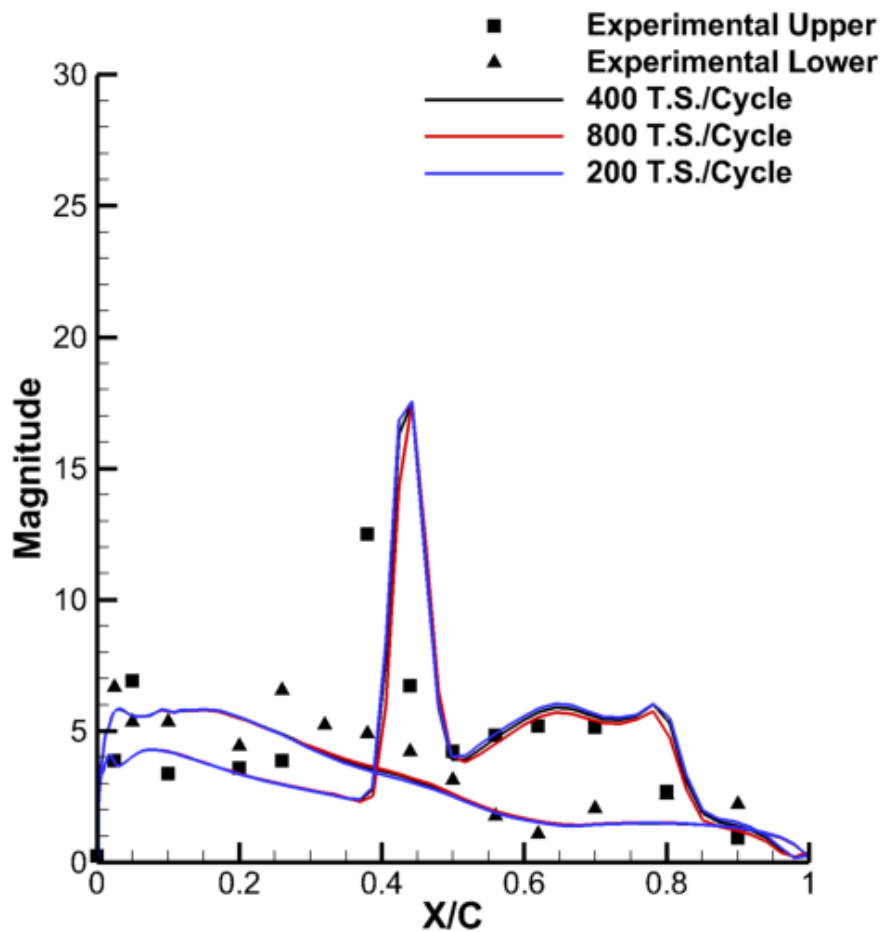
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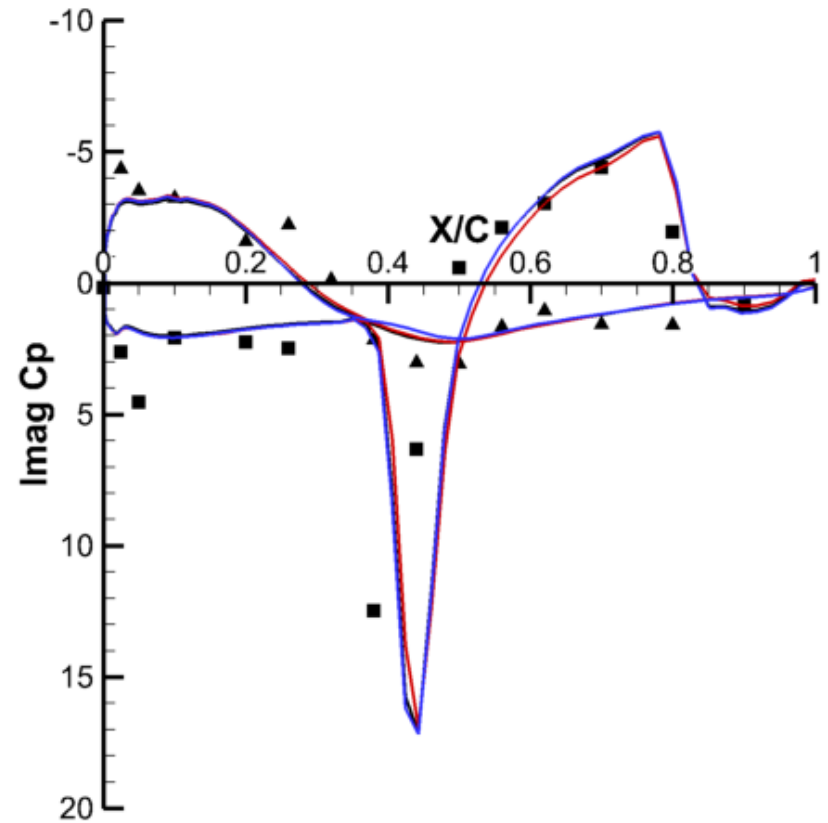
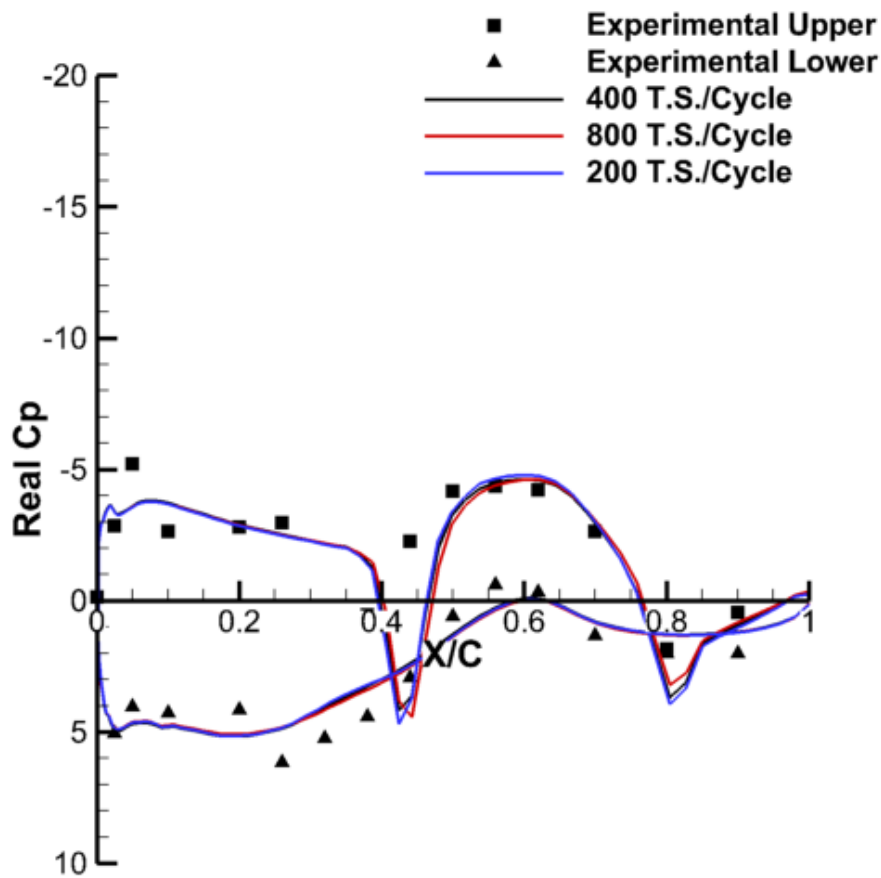
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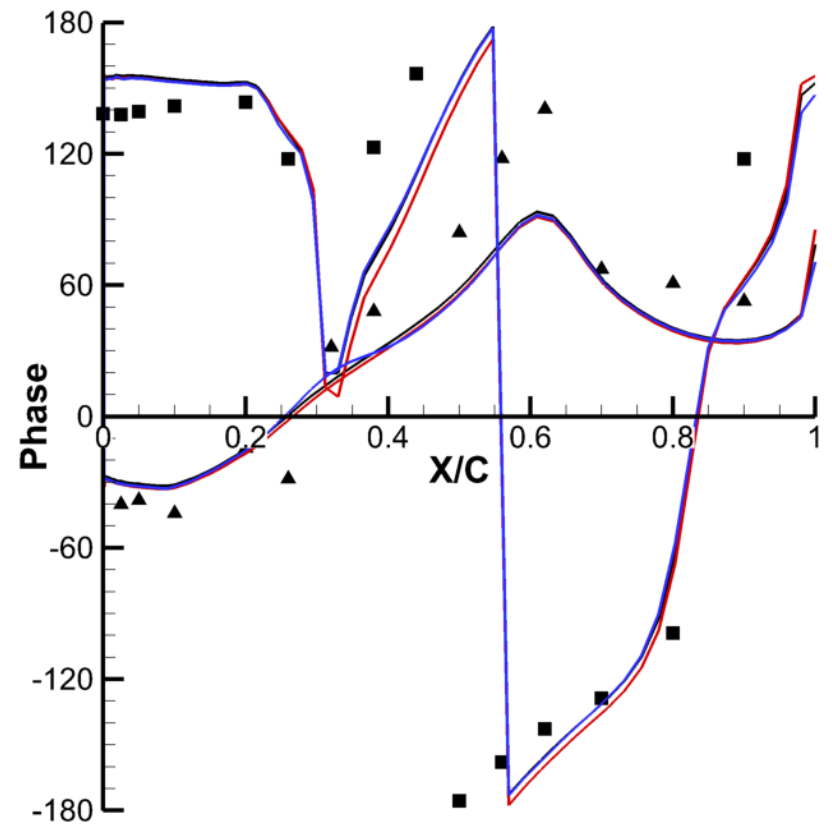
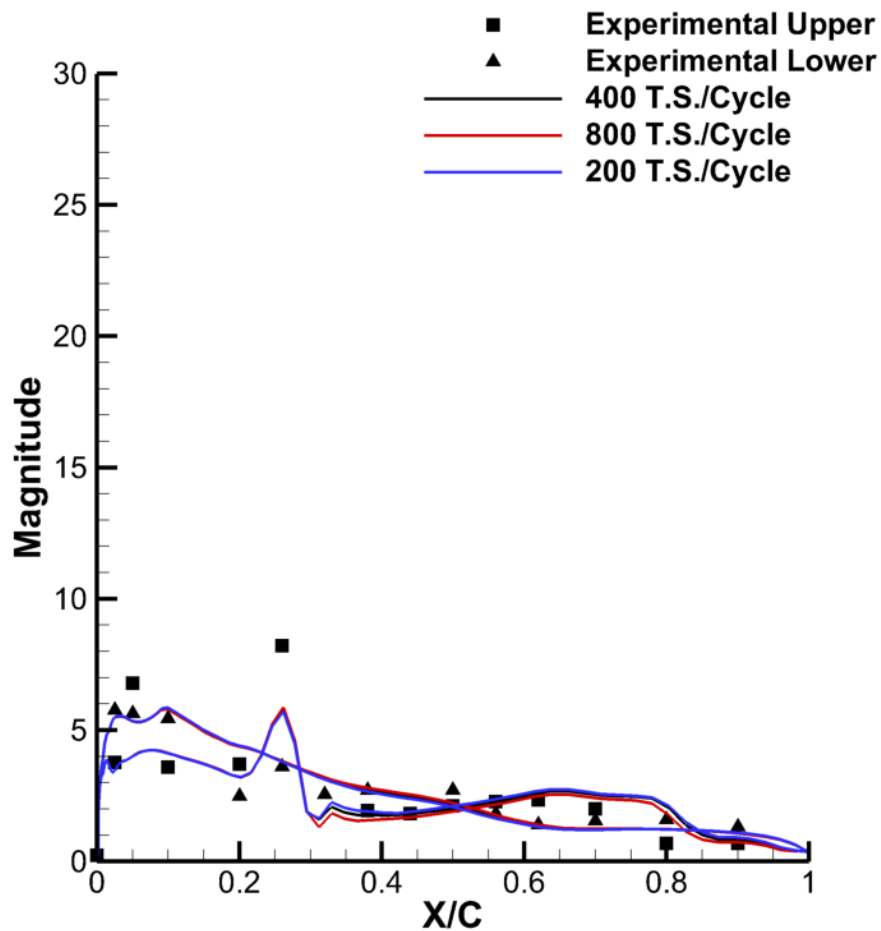
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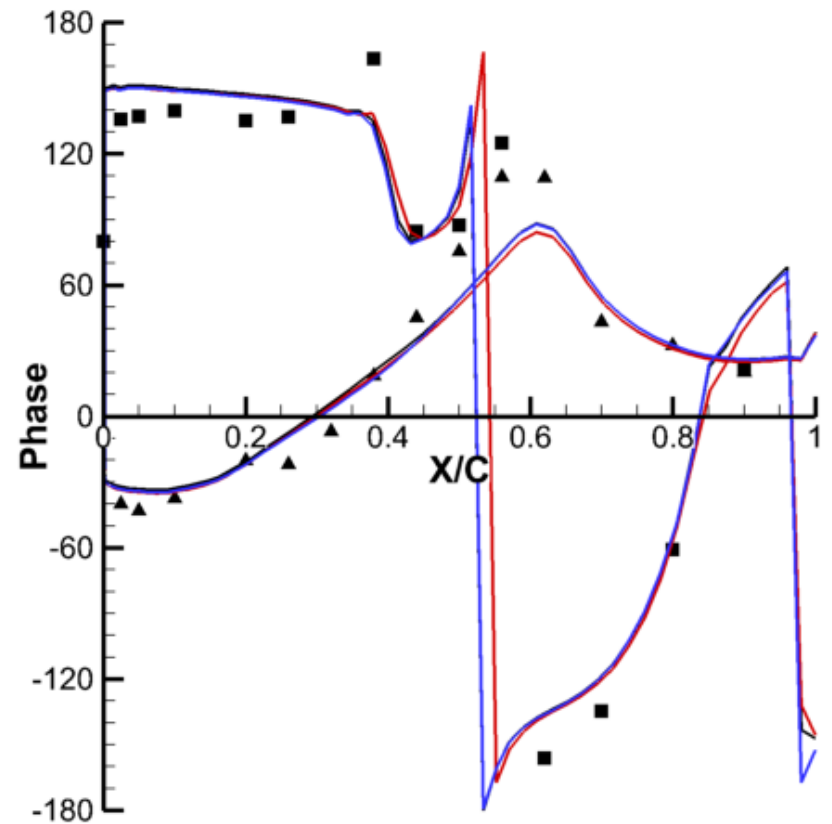
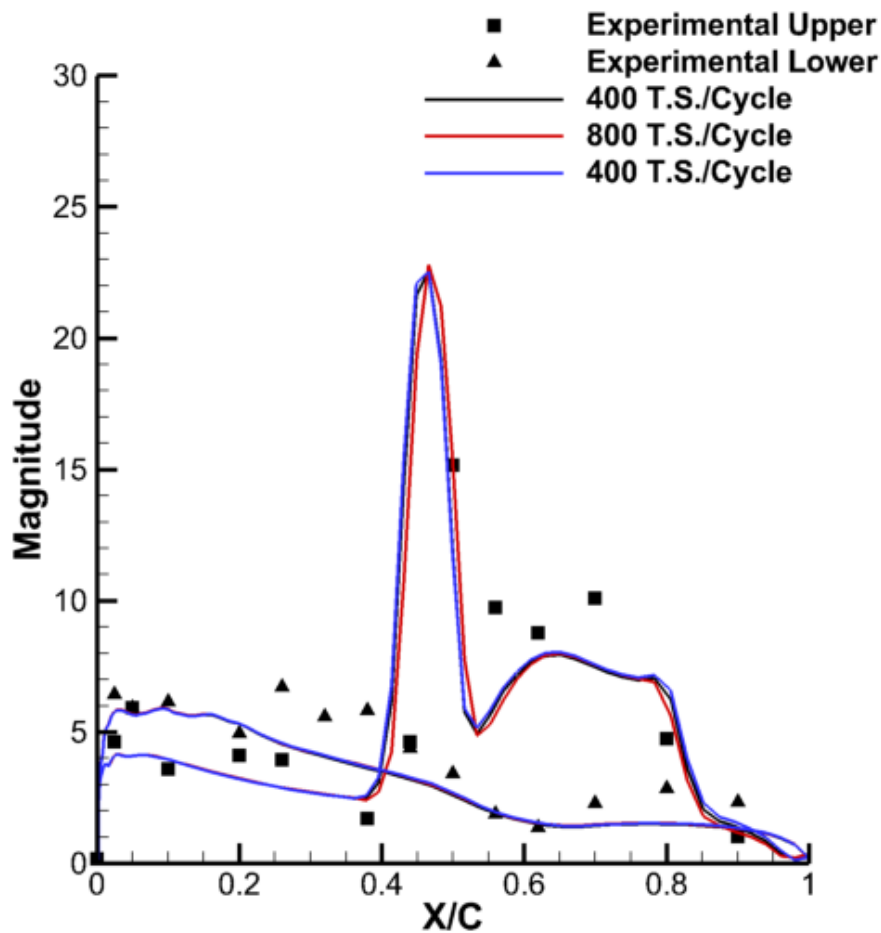
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