CFL3D Analysis of the Benchmark Supercritical Wing (BSCW)

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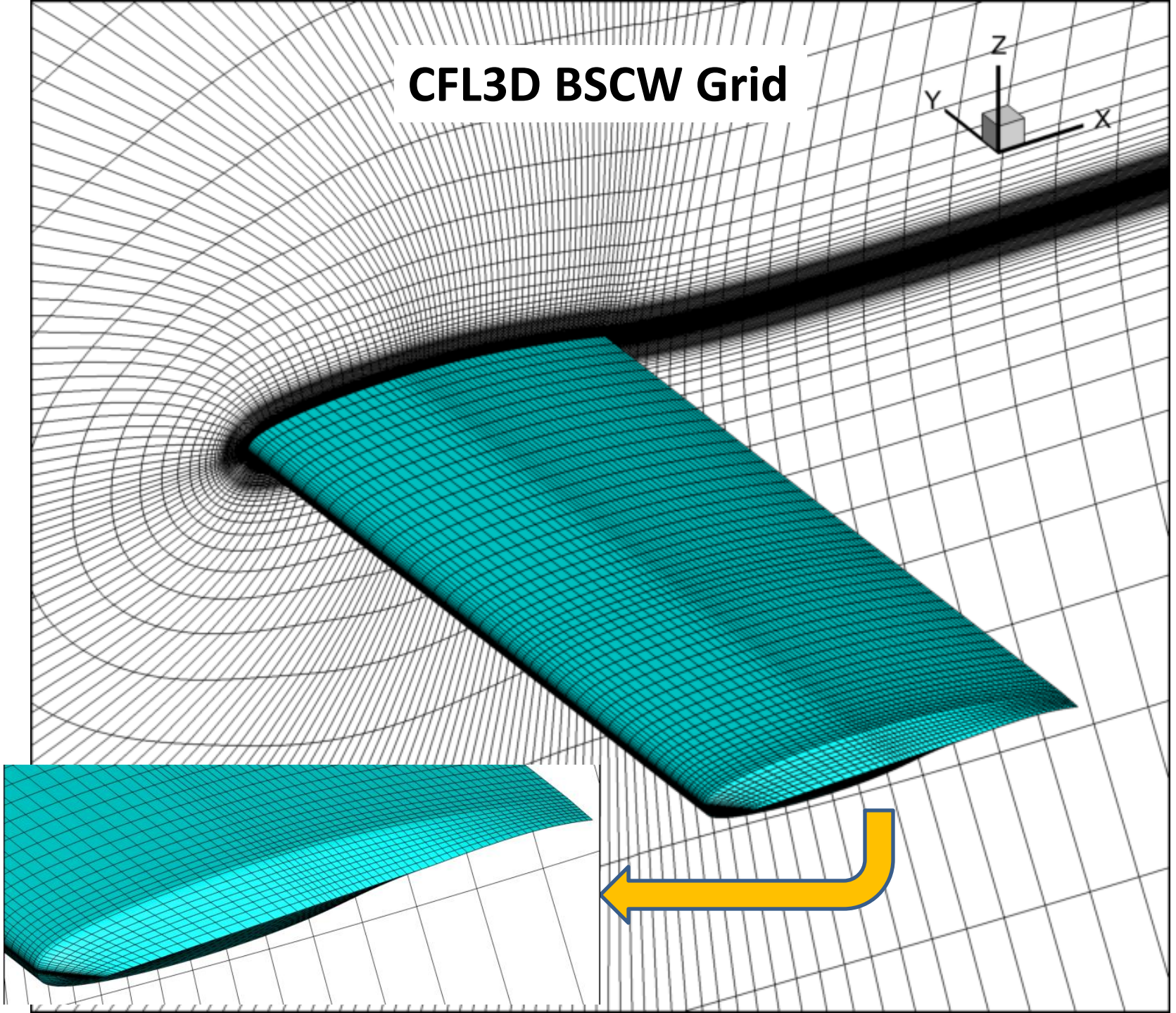
Analysis Summary

- 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 $\alpha = 2.0^{o}$ 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.

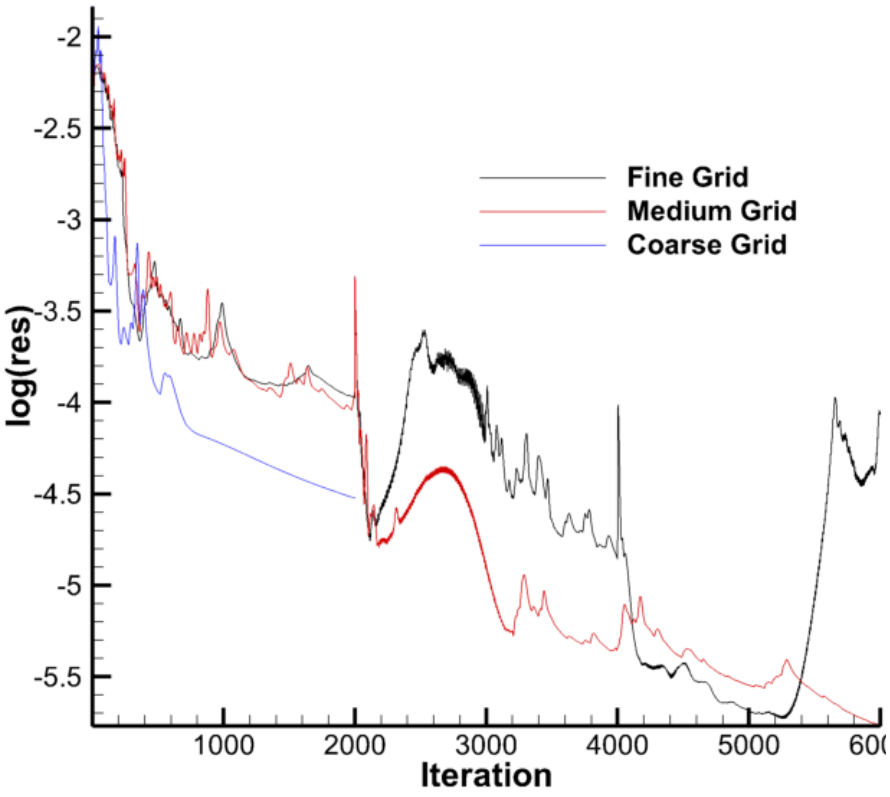
Geometry Analysis and grid Generation Details

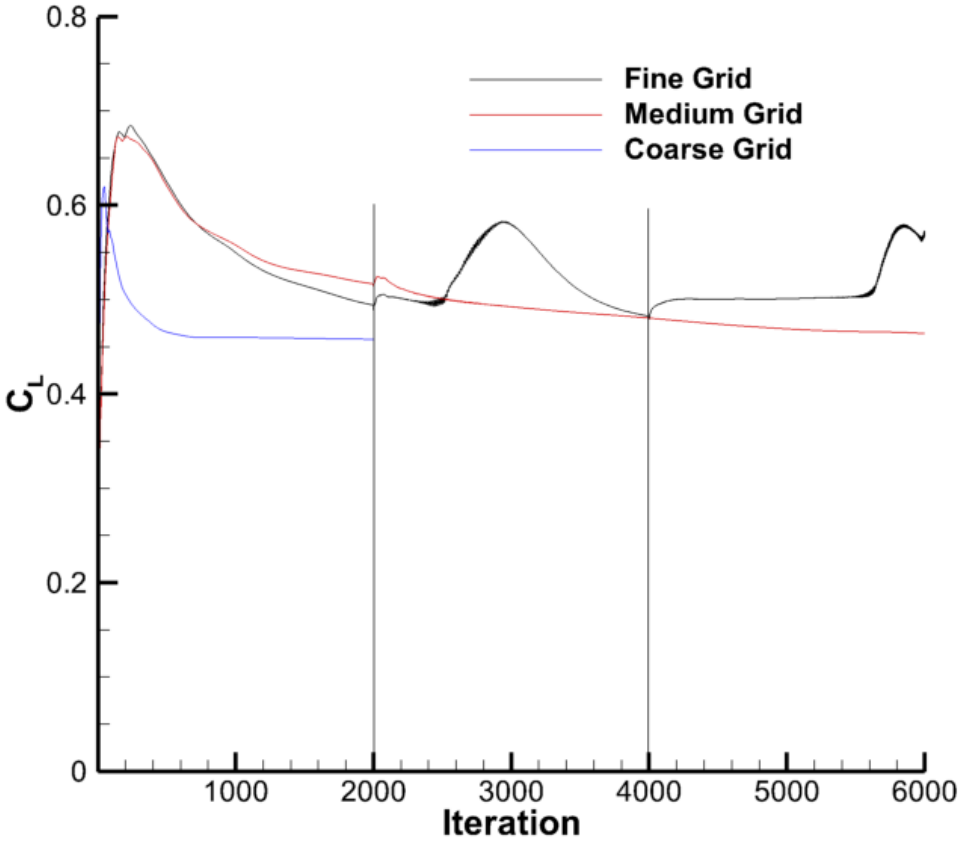
- Grids clustered to resolve BL on both the wing surface.
- Wing tip scarfed rather than rounded.
- Addditional points clustered near wing surface in attempt to better capture separation.
- Steady grids:
  - Coarse – 113 x 49 x 37 = 204,869 pts.
  - Medium – 225 x 97 x 73 = 1,593,225 pts.
  - Fine – 449 x 193 x 145 = 12,565,265 pts.
- Unsteady grid:
  - Same grid size as medium grid, but surface point distribution modified to accommodate CFL3D's moving grid algorithm.

CFL3D BSCW Grid

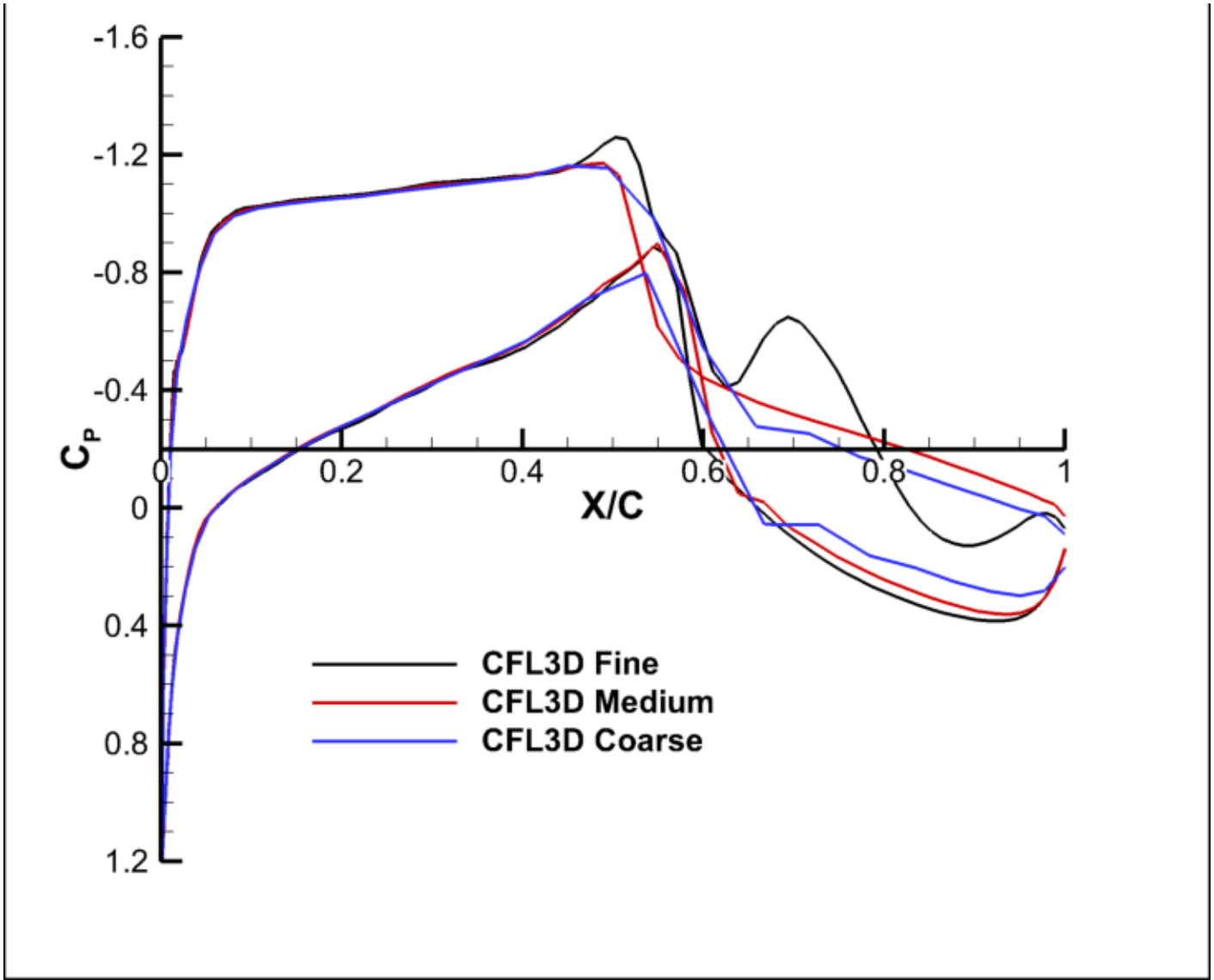


BSCW Grid Convergence

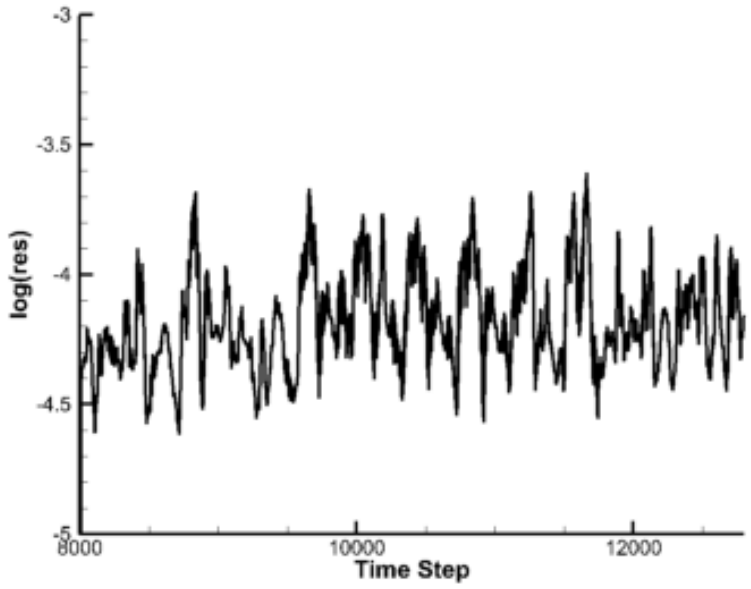


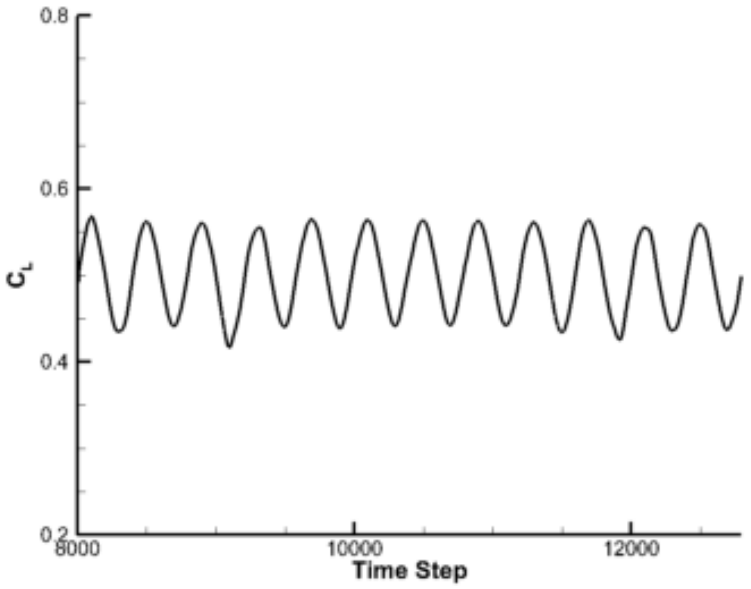


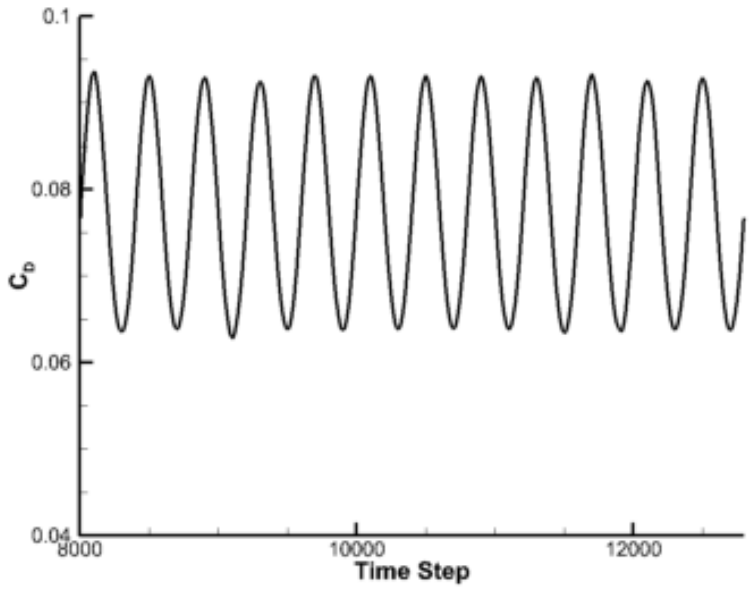
Steady BSCW CFL3D Analysis
M=0.85 α=5.00 η=0.60

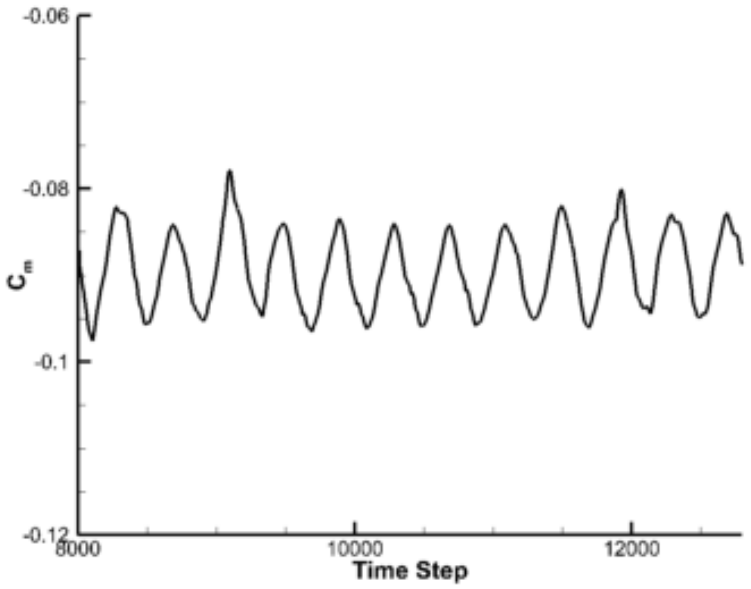


BSCW CFL3D Analysis
M = 0.85, α = 5.0 °, θ = 1.0°, f = 1.0 Hz









BSCW CFL3D Analysis

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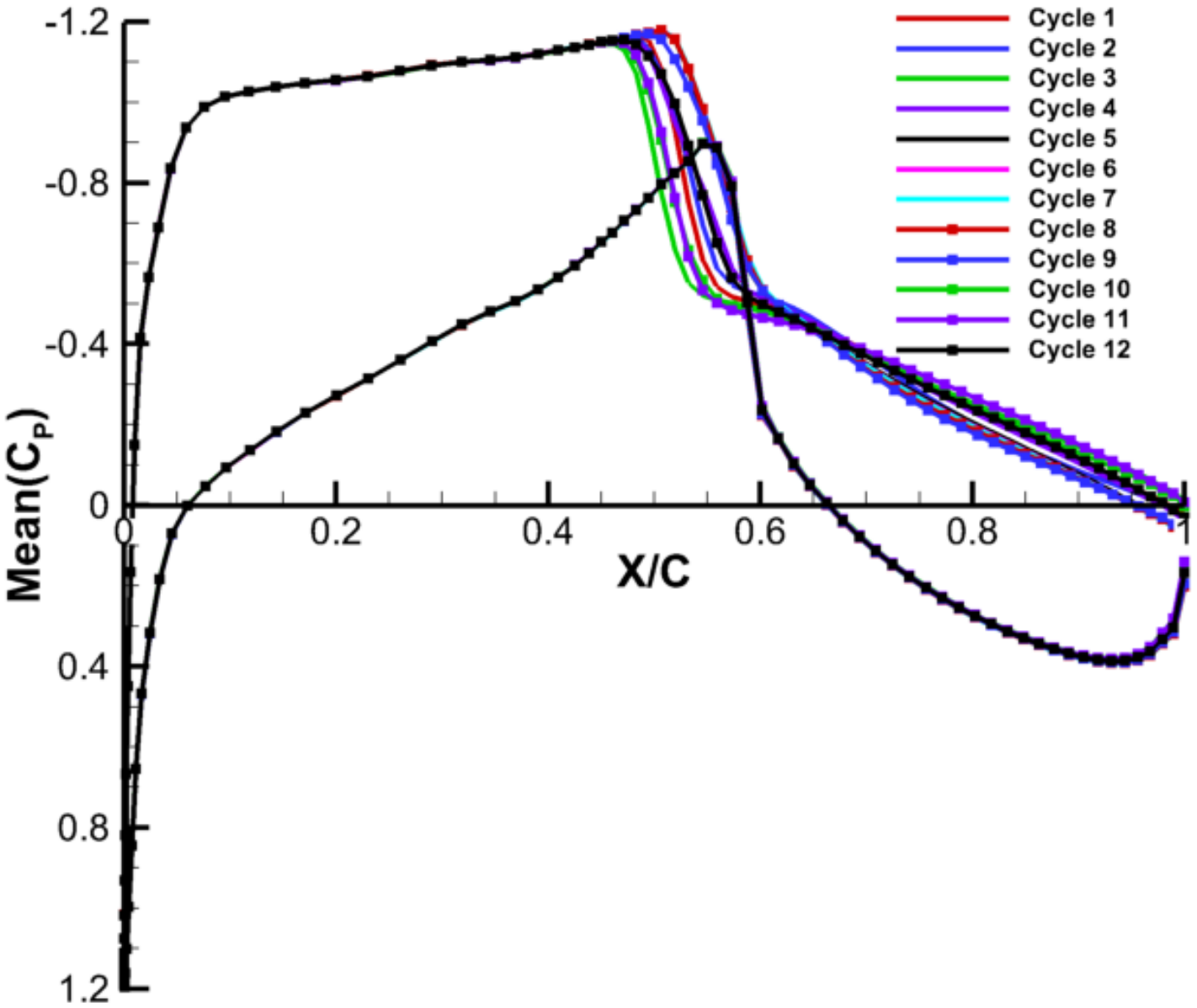

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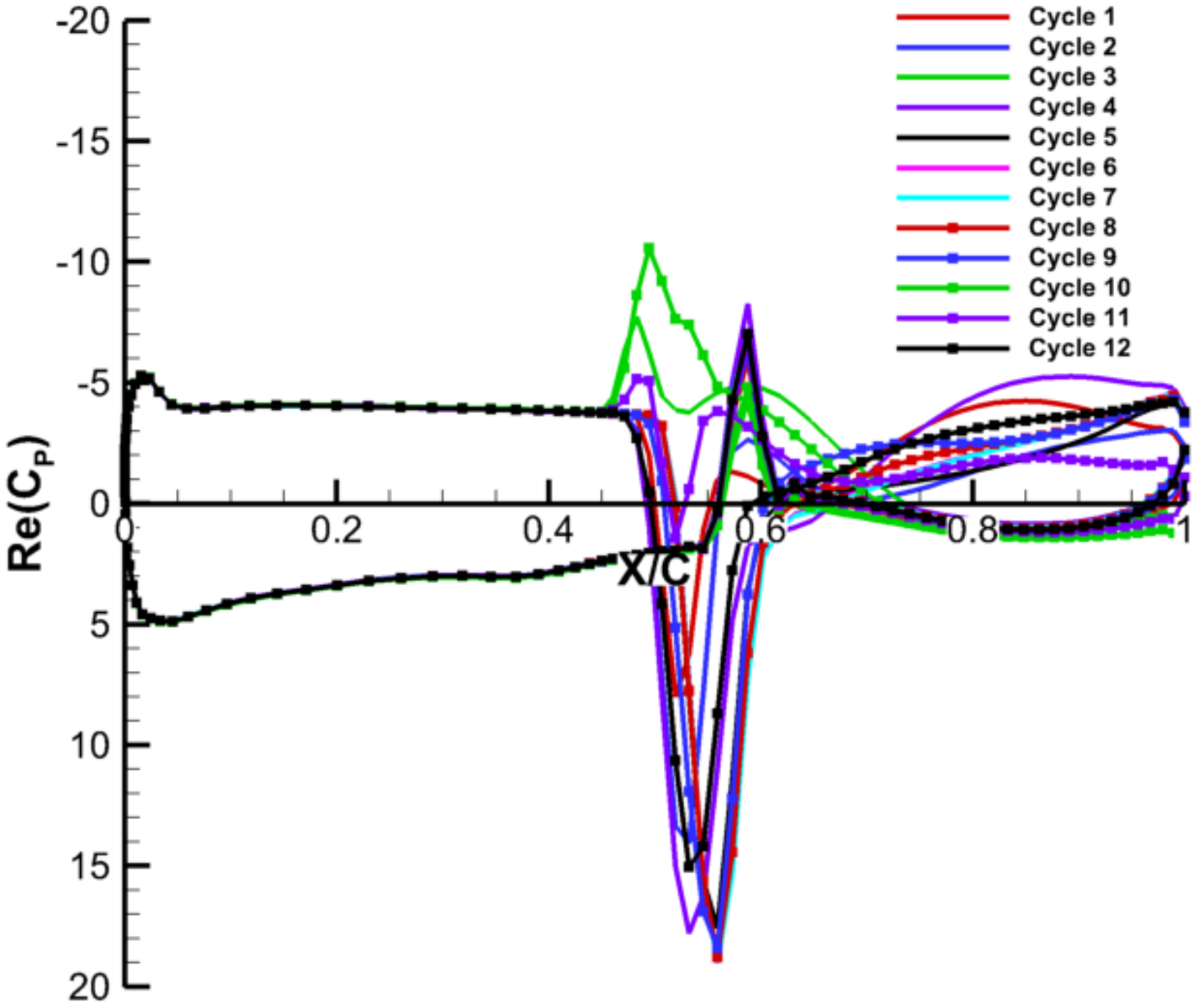

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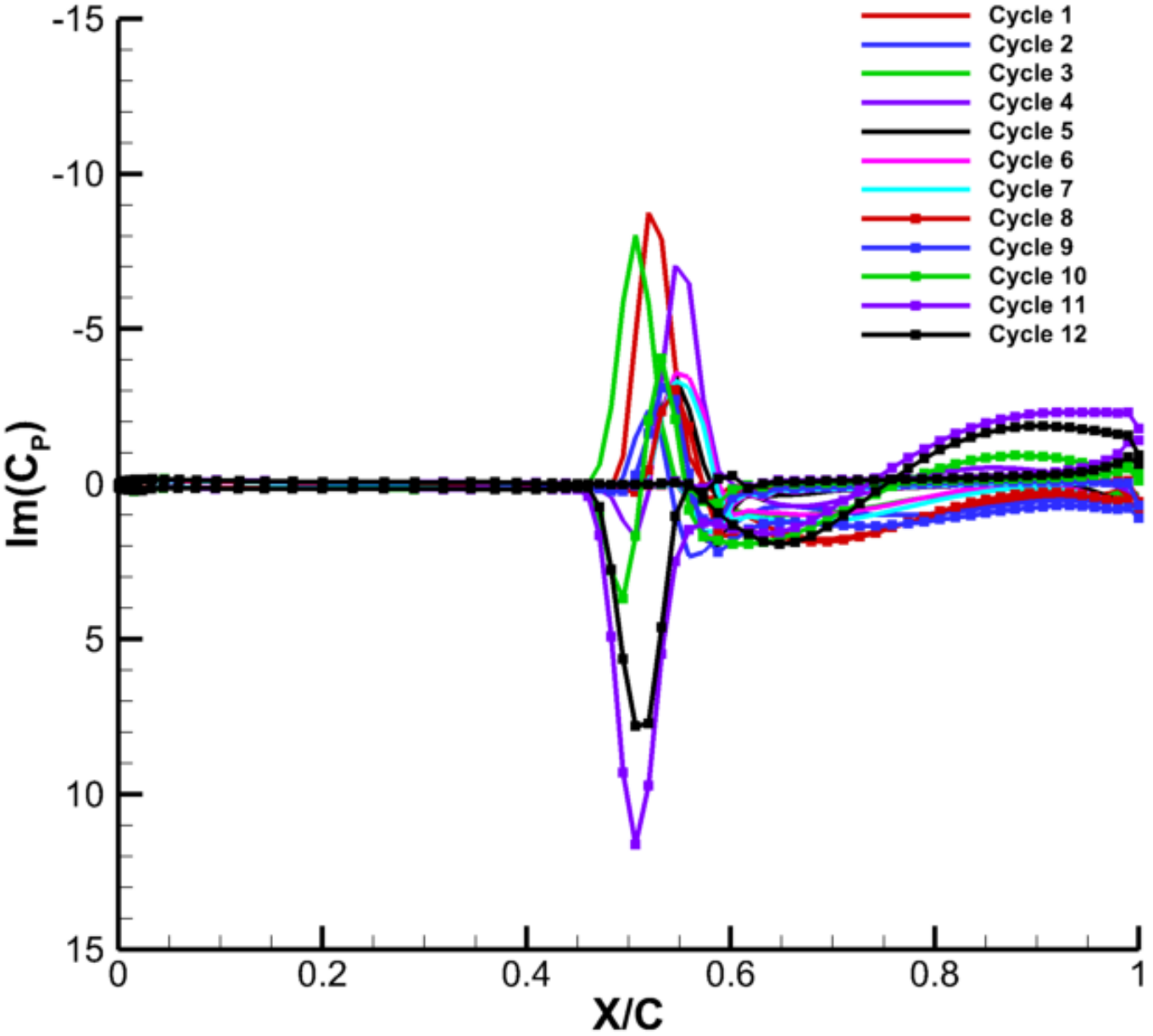

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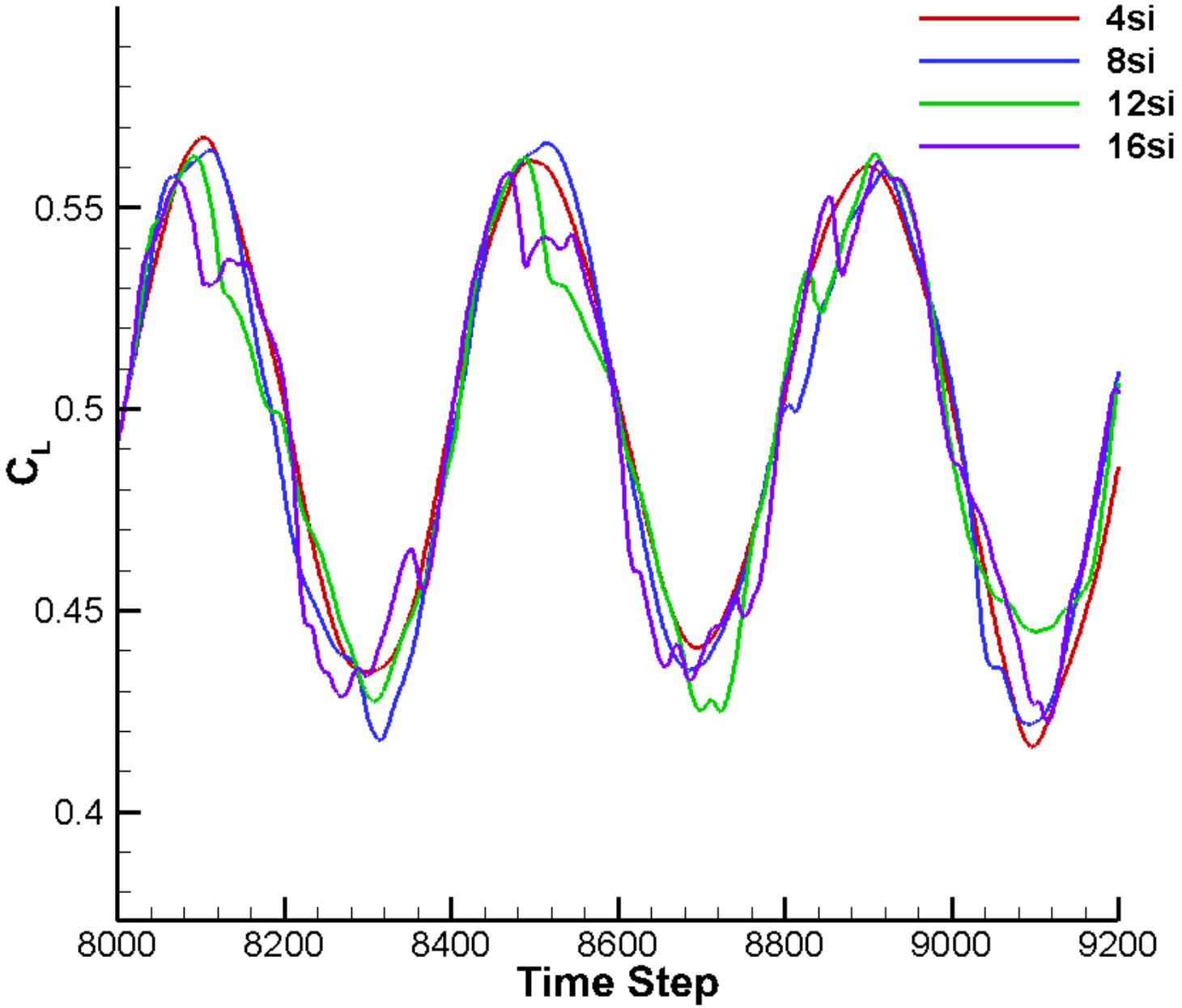

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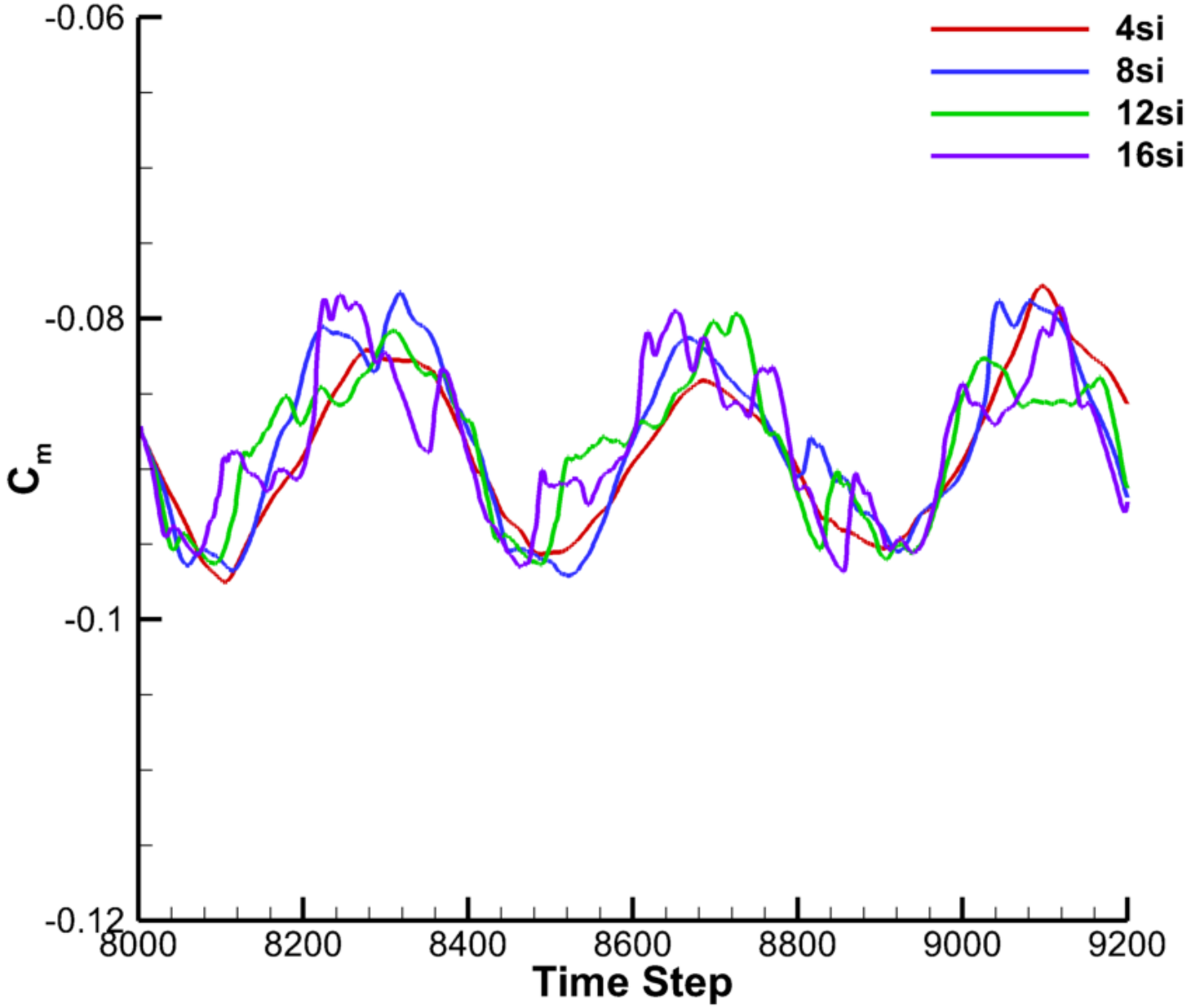

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