Results for the C3.8 test case with the DLR-PADGE code

Ralf Hartmann
Institute of Aerodynamics and Flow Technology
German Aerospace Center

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Test case C3.8: CRM wing/body

Flow conditions (DPW-5, Case 1):

- Mach number: $M = 0.85$
- Target $C_L = 0.5$ ($\pm 0.001$)
- Reynolds number: $5 \times 10^6$ (based on reference chord $c_{ref} = 275.80$ inch)

Additional information:

- Moment reference center at $(x, y, z)_{ref} = (1325.90, 468.75, 177.95)$ in [inch]
- Reference area (half model): $A_{ref} = 297360$ (inch)$^2$
- Fully turbulent flow, no transition
- Steady-state RANS
- Free air farfield boundary, no modeling of support structures or wind tunnel walls
Test case C3.8: CRM wing/body
Turbulent flow at $M = 0.85$, $Re = 5 \times 10^6$ with $C_L = 0.5$

Curved hexahedral mesh (cubic lines) from the workshop homepage
- crm_q3.msh with 79505 elements (initial mesh)
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Methods in the DLR-PADGE code used for this test case
Discontinuous Galerkin discretization of the RANS and Wilcox $k$-$\omega$ equations
   ▶ Legendre polynomial basis functions of polynomial degree 1.
   ▶ Roe flux with Harten entropy fix (fix fraction=0.2)
   ▶ BR2 discretization of viscous terms
   ▶ Characteristic farfield boundary conditions
   ▶ Adiabatic wall boundary condition

Flow solver:
   ▶ Backward Euler (fully implicit solver) with ILU preconditioned GMRes
   ▶ Damping of updates to ensure that pressure and density do not decrease more than 20% in each iteration step

Convergence criterion: Reduction of the (vector-) $L^2$-norm of the residual vector to $10^{-12}$ relative to freestream conditions
C3.8: Convergence histories for residual-based mesh refinement

initial grid: 318.020 DoFs/eqn, constant $\alpha = 2.25^\circ$

Step 1: 482.988 DoFs/eqn, final $\alpha = 3.047^\circ$

Step 2: 814.048 DoFs/eqn, final $\alpha = 2.773^\circ$

Step 3: 1.414.432 DoFs/eqn, final $\alpha = 2.567^\circ$

Step 4: 2.674.652 DoFs/eqn, final $\alpha = 2.461^\circ$

Step 5: 5.298.416 DoFs/eqn, intermediate $\alpha = 2.292^\circ$

not yet fully converged
(restart of target $C_L$ computations not yet implemented)
Test case C3.8: CRM wing/body

Turbulent flow at $M = 0.85$, $Re = 5 \times 10^6$ with $C_L = 0.5$ ($\pm 0.001$)

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Turbulent flow at $M = 0.85$, $Re = 5 \times 10^6$ with $C_L = 0.5$

$\alpha = 2.292^\circ$, 5.298.416 DoFs/eqn
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Following slides:
- $c_p$ on wing section 04 $\eta = 0.1306$
- wing section 10 $\eta = 0.5024$
- wing section 12 $\eta = 0.7268$
- wing section 14 $\eta = 0.9500$
Test case C3.8: CRM wing/body

Turbulent flow at $M = 0.85$, $Re = 5 \times 10^6$ with $C_L = 0.5$

Solution for $\alpha = 2.292^\circ$ on 5 times residual-based refined mesh with 5,298,416 DoFs/eqn.
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