Gaspar García, CFD portfolio

Caveated

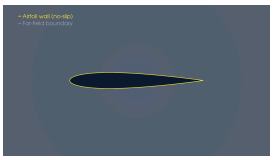
Updated 2026-11-14

NACA 0012 at 10 degrees: lift extrapolated from three grids sits +2.14 % above a reference code and +3.4 to +3.8 % above experiment

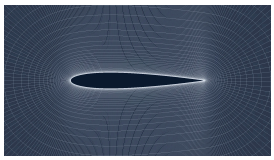
Objective. Predict the lift of a NACA 0012 at 10 degrees and Re 6 million with k-omega SST on a three-grid ladder, with a numerical uncertainty, against the NASA TMR reference computation and experiment.

Parameters

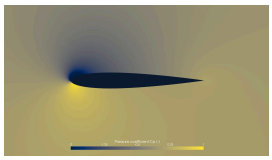
Reynolds number (chord)	6 million
Angle of attack	10°
Fluid	Incompressible, unit speed and chord
Solver	OpenFOAM simpleFoam, steady
Turbulence model	k-omega SST, fully turbulent
Wall y+ max	1.65 coarse, 0.85 finest
Cells	48,120 to 193,200
Free-stream velocity	(0.984808 0.173648 0)



1 Geometry



2 Mesh

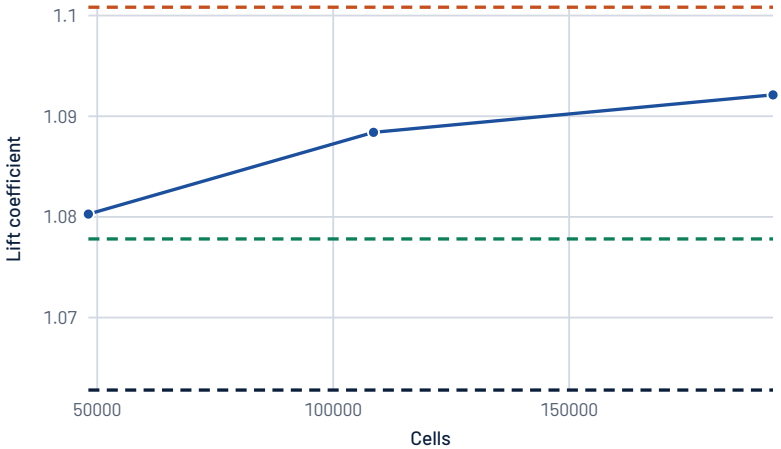


3 Results

Comparison with the references

Quantity	Reference	Simulation	Signed difference
Lift, extrapolated, vs CFL3D (computation)	1.07781	1.10083	+2.14 %
Lift at 10 degrees, grid-corrected, vs Ladson (experiment)	1.0628	–	+3.59 %
Lift, grid-corrected, 8 to 14 degrees, vs Ladson	–	–	+3.41 to +3.77 %
Suction peak Cp vs CFL3D, coarse grid	−5.60	−5.5924	0.14 % smaller in magnitude

Lift coefficient against Cells



Verdict

Lift extrapolates to 1.10083, +2.14 % above CFL3D and +3.4 to +3.8 % above the Ladson experiment after grid correction, with a GCI of about 1.00 %. The finest grid fails one checkMesh test and drifts above the convergence gate, so the case is listed with caveats.

Limits

- Finest grid fails checkMesh (aspect ratio, 12 undocumented cells).
- Three grids only: the order cannot be checked; drag is not grid-converged.
- The NACA 4412 run is not blind and is not compared here.

1. NASA Turbulence Modeling Resource, 2-D NACA 0012 validation case: CFL3D SST results (n0012clcd_cfl3d_sst.dat, n0012cp_cfl3d_sst.dat), as stored locally.
2. Ladson, NASA TM 4074, 1988: lift and drag at Re 6 million, transition tripped, M 0.15 (TMR file CLCD_Ladson_expdata.dat).
3. Gregory & O'Reilly, NASA R&M 3726, Jan 1970: upper-surface pressure at Re 2.88 million, digitised (TMR file CP_Gregory_expdata.dat).
4. Celik et al.: the unequal-ratio Richardson / GCI procedure, as implemented in the project's gci.py.

Full page with sources, mesh and numerical accuracy: /cases/naca-0012/. Every number is checked against its source file.