Gaspar García, CFD portfolio

Caveated

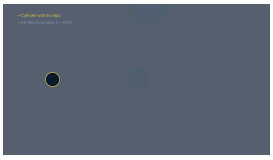
Updated 2026-11-14

Laminar cylinder wake at Re 150: the Strouhal number is within 0.84 % of a published simulation on all four grids

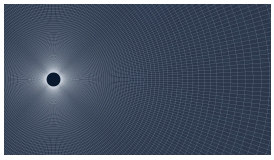
Objective. Reproduce laminar vortex shedding behind a circular cylinder at Re 150 on a four-grid ladder and compare the shedding frequency and forces with a published 2-D simulation.

Parameters

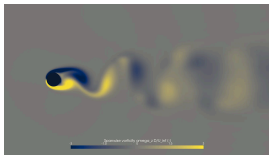
Reynolds number (free-stream speed, diameter)	150
Scales	Non-dimensional: D = 1, U = 1, kinematic viscosity 0.006666666667 (1/Re)
Domain	O-grid to a radius of 50 D
Solver	OpenFOAM v2412, pimpleFoam (transient, incompressible)
Turbulence model	None: laminar
Wall treatment	Resolved: first radial cell 0.0067 D on the finest grid
Time step, finest grid	0.005
Cells	5,600, 11,200, 22,572, 44,800



1 Geometry



2 Mesh

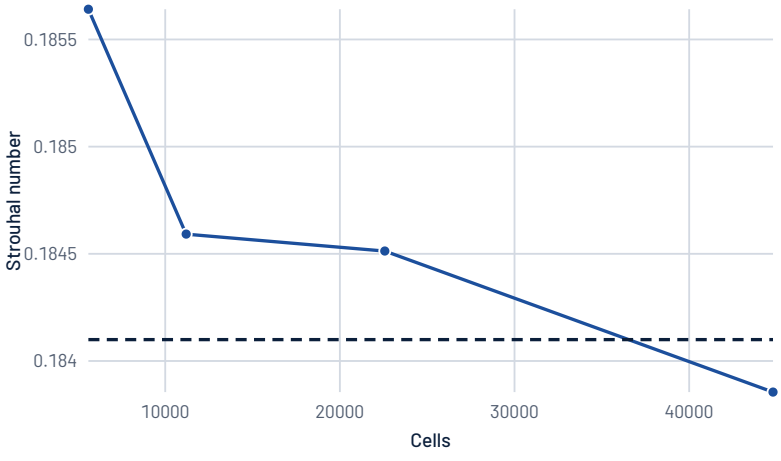


3 Results

Comparison with the reference simulation

Quantity	Reference (Qu et al. 2013)	Simulation, finest grid	Signed difference
Strouhal number	0.1841	0.183855	**−0.13 %**
Mean drag coefficient (non-monotone in the grid)	1.305	1.32266	**+1.35 %**
rms lift coefficient (non-monotone in the grid)	0.3546	0.374123	**+5.5 %**
rms drag coefficient (non-monotone in the grid)	0.0173	0.0189802	**+9.7 %**

Strouhal number against Cells



Verdict

The Strouhal number is 0.1839 on the finest grid, −0.13 % from the reference and within 0.84 % on all four grids. The ladder is not monotone on the three finest grids and the forces have no defensible band, so only the frequency is claimed.

Limits

- Code-to-code: the reference is a simulation, not an experiment.
- Three-grid GCI refused for St; the least-squares band leans on the coarsest grid.
- Drag and lift fluctuations converge non-monotonically; noise level not shown (no numeric reference).

1. Qu, L., Norberg, C., Davidson, L. (2013), Quantitative numerical analysis of flow past a circular cylinder at Reynolds number between 50 and 200, J. Fluids Struct. 39, 347-370 (author's version, Chalmers Publication Library). Table 3.
2. Inoue, O. & Hatakeyama, N. (2002), Sound generation by a two-dimensional circular cylinder in a uniform flow, J. Fluid Mech. 471, 285-314. Not obtained; its St is known here only second-hand and is not used.
3. Eça and Hoekstra (2014): the least-squares numerical-uncertainty procedure, as implemented in the project's gci.py.

Full page with sources, mesh and numerical accuracy: /cases/cylinder-re150/. Every number is checked against its source file.