

2nd International Workshop on High-Order CFD Methods – Testcase C3.1

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Wissen für Morgen

DG discretization

Basis functions

- non-parametric ortho-normal basis functions
- directly formulated in physical space
- need to be evaluated for each mesh element

RANS- $k\omega$ equations

- $k\omega$ turbulence model
- BR2 for the viscous terms
- Roe flux as a convective flux
- farfield boundary condition using a vortex correction based on potential theory



Numerical algorithms

Solver choice

- startup strategy in mesh or order sequencing for improved initial conditions
- non-linear MG to accelerate process in pseudo-time
 - a linearized Backward-Euler scheme as smoother
 - using an SER time stepping scheme for the Backward-Euler
- linear MG as preconditioner for a GMRES method
 - line-Jacobi scheme as smoother

Galerkin-transfer to obtain the Jacobian on the lower levels is used in all multigrid algorithms.



Testcase 3.1

Mesh hierarchy with meshes from the University of Bergamo:

- structured hexahedral meshes
- farfield distance between 35 and 100 cord lengths
- 3218 els and 12872 els

Mesh hierarchy with meshes from the DLR:

- structured hexahedral meshes
- farfield distance between 44 and 50 cord lengths
- 2108 els, 8432 els, 33728 els and 134912 els



Testcase 3.1

Reference values from finite volume computation
by Stefan Langer (DLR).

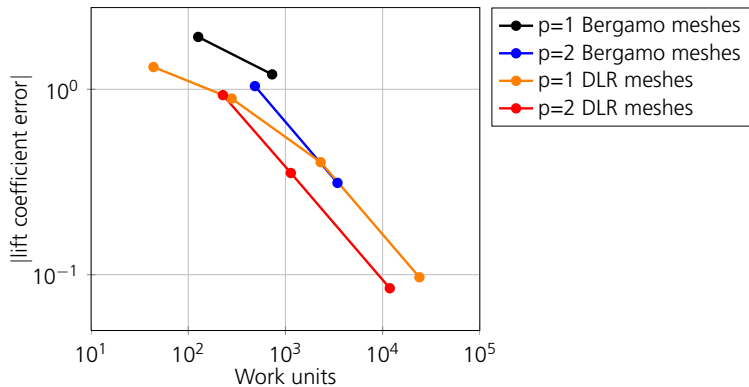
$$\rightarrow C_L^{ref} = \mathbf{4.14}$$

$$\rightarrow C_D^{ref} = \mathbf{0.04975}$$

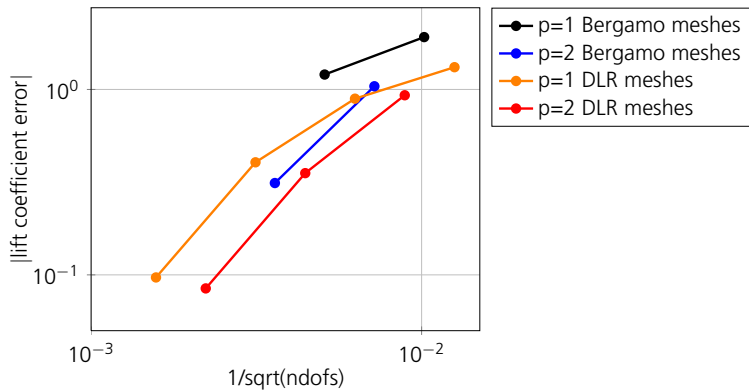
Tau Bench on the DLR CASE-CLUSTER : **8.1523** sec



Testcase 3.1

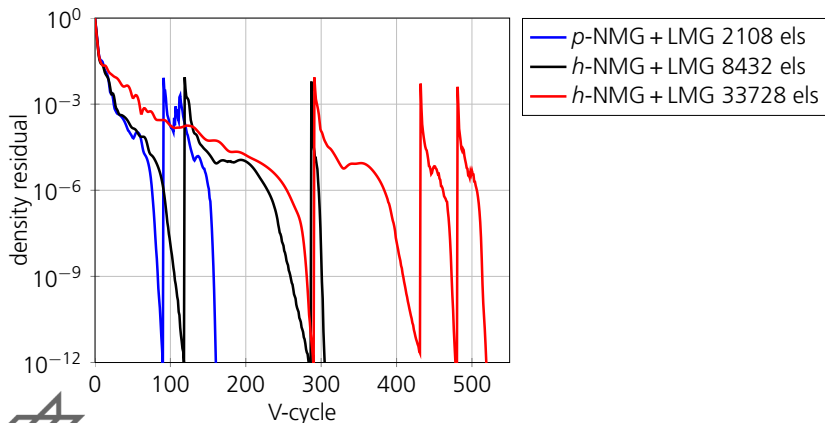


Testcase 3.1



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Convergence plots of $p = 2$ computations on the DLR mesh hierarchy.



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