

## Revised abstract for Testcase C3.1

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# 1 Code description

Our DG code implements higher order discontinuous Galerkin methods on unstructured mixed-element curvilinear meshes.

Parameter settings for the test case will be:

- Discretization/Higher order capability:
  - Hierarchical polynomial basis functions of polynomial degrees 1-3.
  - Basis definition in physical space.
  - Roe flux and an entropy fix is used in order to ensure non-vanishing dissipation.
  - BR2 scheme
  - turbulence model
    - \* Spalart-Allmaras (2012)
    - \* Wilcox  $k\omega$  (1988)
- Solver capability
  - Non-linear  $p$ - or  $h$ -multigrid with a Backward-Euler smoother.
  - As timestep control a *switched evolution relaxation* (SER) technique is employed to modify the CFL number during the solution process.
  - Linear solver: GMRES with a linear  $p$ - or  $h$ -multigrid preconditioner.
  - Smoother for the linear multigrid is a line based Jacobi scheme.

# 2 Case summary

Mesh hierarchy with meshes from the DLR:

- structured hexahedral meshes
- farfield distance approx. 50 chord lengths
- 2 108, 8 432, 33 728 and 134 912 elements

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The computations are based on  $\gamma = 1.4$  (ratio of specific heats) for air. The Prandtl number was set to  $Pr = 0.72$  in contrast to the Prandtl number of 0.71 specified in the test case description. Moreover, Sutherland's law is used but a reference temperature of  $290K$  is applied in contrast to the requested  $288K$ .

### 3 Results

The FV results, marked with a  $\blacktriangle$ , are taken from the second HOW. Note that, the meshes of these FV results differ from our mesh hierarchy. All computations use the Spalart-Allmaras turbulence model.

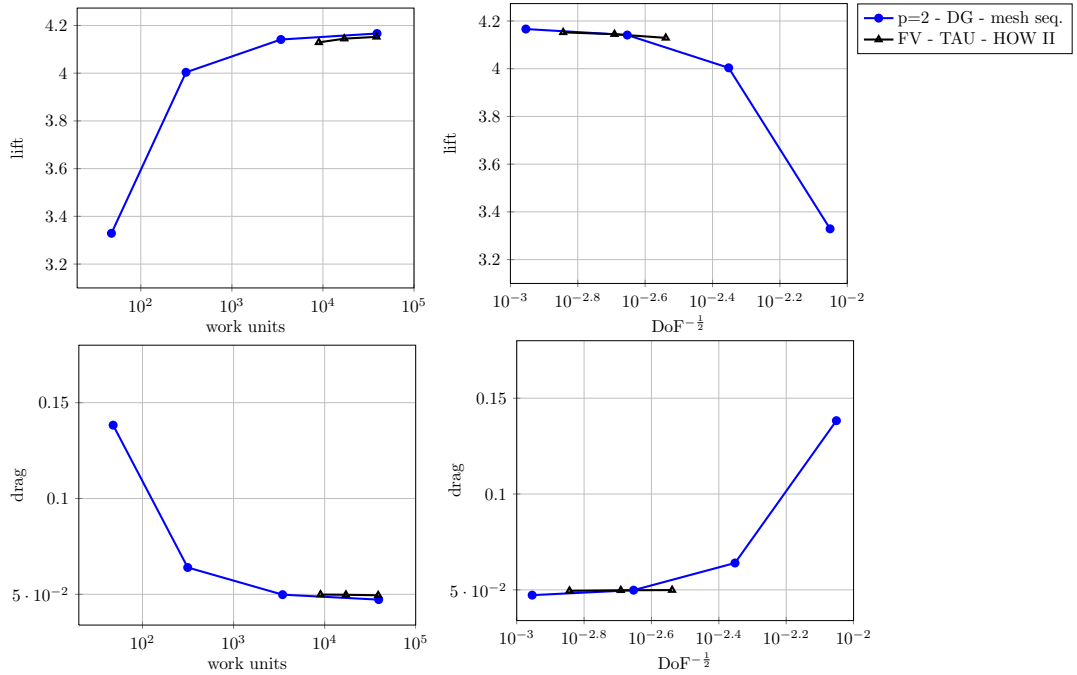
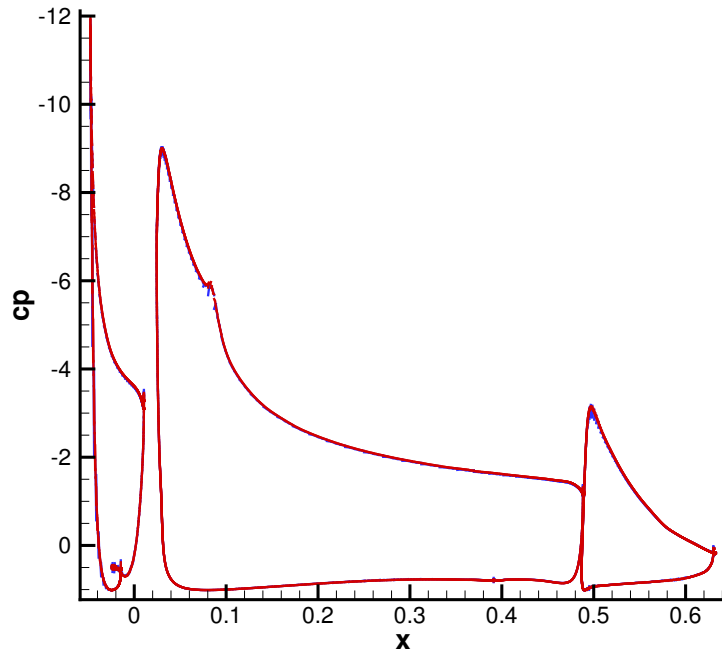


Figure 1: Left: Lift and drag in correlation to work units. Right: Lift and drag in correlation to DoF.

element no.	polynomial degree	$C_L$	$C_D$	DoF	work units	processors
2108	2	3.32903	0.138278	12648	47.60	2
8432	2	4.0038	0.0639985	50592	313.66	4
33728	2	4.14119	0.049819	202368	3455.24	8
134912	2	4.16634	0.0472271	809472	39237.52	16

Table 1: Data of the MDA 30P30N ( $p = 2$ ) *SA*-computations on a structured mesh hierarchy.



$C_p$ -distribution on 33 728 (blue) & 134 912 (red) element meshes.