

# R-006 – Siemens Digital Industries Software

- Flow solver: Simcenter STAR-CCM+ (v2306 for Case 1, v2310 for Case 2)
- Spatial discretization: 2<sup>nd</sup> order or MUSCL 3<sup>rd</sup>-order/CD for mean flow, 2<sup>nd</sup>-order for turb.
- Iteration method: Preconditioned Coupled Flow Solver with automated CFL control and explicit relaxation (local pseudo-time-stepping)
- Name of committee grids (or “self-prepared”): Self-Prepared from Simcenter STAR-CCM+ for Case 1 and 2 and 1.R.01 grids for Case 1
- Cases submitted: 1 and 2.1, 2.2, 2.3, and 2.4
- Initialization method: Grid-sequencing initialization for first point in AOA sweep, then initialize next AOA from previous AOA solution (warm start)
- Turbulence model: SA-QCR-R, SST (with  $a_1=1$ ), and Lag Elliptic Blending k-epsilon for Case 1, SA and SST (with  $a_1=1$ ) for Case 2
- Convergence/stopping criteria: CL, CD, CM variation all less than  $1e-3$  over last 1000 iterations OR Running average of CL (2000 iteration avg) changes less than  $1e-3$  over last 5000 iterations (for efficiency in cases where F&M coefficients are oscillating) or 10000 iterations per AOA point
- Relevant publications related to solver and/or high-lift applications:

Shankara, P., Hanke, J., and Snyder, D. O. “Numerical Simulation of DLR-F11 High Lift Configuration from HiLiftPW-2 using STAR-CCM+.” 52nd Aerospace Sciences Meeting. AIAA Paper 2014-0914, Jan. 2014. <https://doi.org/10.2514/6.2014-0914>

M. Zastawny, S. Lardeau, and S. Evans, “Investigation of RANS modelling techniques applied to the 3rd AIAA High Lift Prediction Workshop test cases,” 2018.

Zastawny, M., Hanke, J., and Nelson, C. C. “Fixed Grid RANS Results and Turbulence Model Investigation using Simcenter STAR-CCM+ for 4th AIAA CFD High Lift Prediction Workshop.” AIAA AVIATION 2022 Forum., AIAA Paper 2022-3746, June 2022. <https://doi.org/10.2514/6.2022-3746>

Hanke, J. “Geometry Preparation and Mesh Generation Using Simcenter STAR-CCM+ for 4th AIAA CFD High Lift Prediction Workshop.” AIAA AVIATION 2022 Forum. AIAA Paper 2022-3520, June 2022. <https://doi.org/10.2514/6.2022-3520>

