Cradle Progress
Fixed Grid RANS TFG

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Software Cradle

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Topic 1 – Flap Deflection Studies

Numerical Method

Numerical method used in this simulation

- Overview

CFD software	scFLOW V2021
Method	Cell-centered finite volume method, Unstructured polyhedral, Density-based solver
Inviscid flux	Roe
Reconstruction	MUSCL, κ=0.5 for the meanflow equations
Limiter	van Leer-type Hishida limiter
Viscous flux	Alpha damping scheme
Gradient	Green-Gauss
Nonlinear solver	Implicit defect correction solver with the residual Jacobian derived exactly from a lower-order discretization with a local pseudo-time step
Linear solver	Block symmetric Gauss-Seidel
Turbulence model	SA-neg

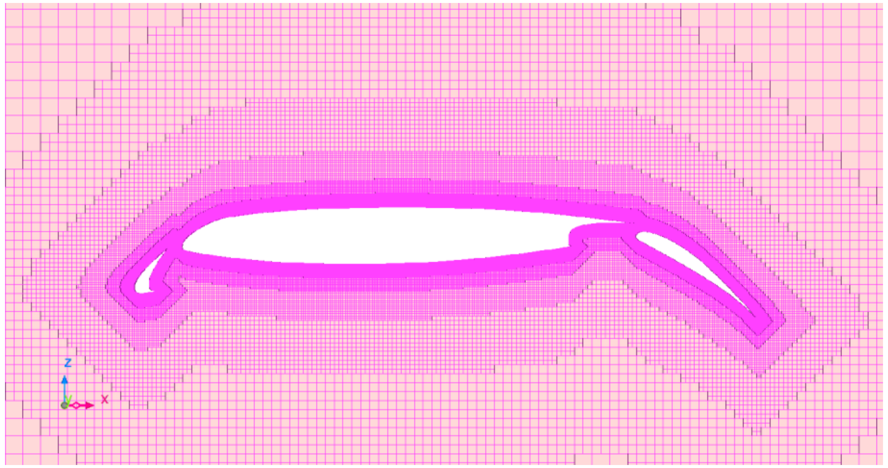
Reference for details

- Higo, Y., Nakashima, Y., Fujiyama, K., Irie, T., and Nishikawa, H., “RANS Solutions on Three Dimensional Benchmark Configurations with scFLOW, a Polyhedral Finite-Volume Solver,” AIAA Aviation 2020 Forum, AIAA Paper 2020-3029, 2020.

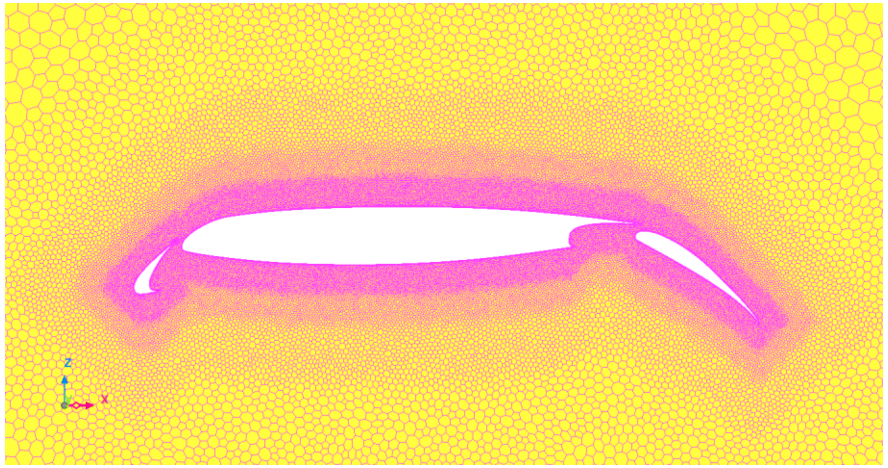
Numerical Method

Overview

- scFLOW is a comprehensive package including mesh generation.
- scFLOW generate Unstructured polyhedral mesh.
- In meshing, the element size is specified by "octant".
- Prism layers are automatically determined from the octant size of the wall surface. (Prism layers become thinner with finer octants)



octant



mesh

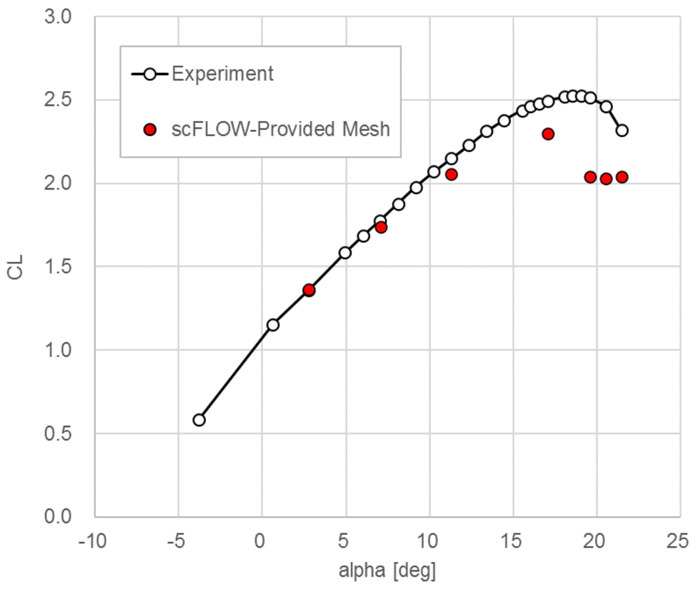
Numerical Conditions

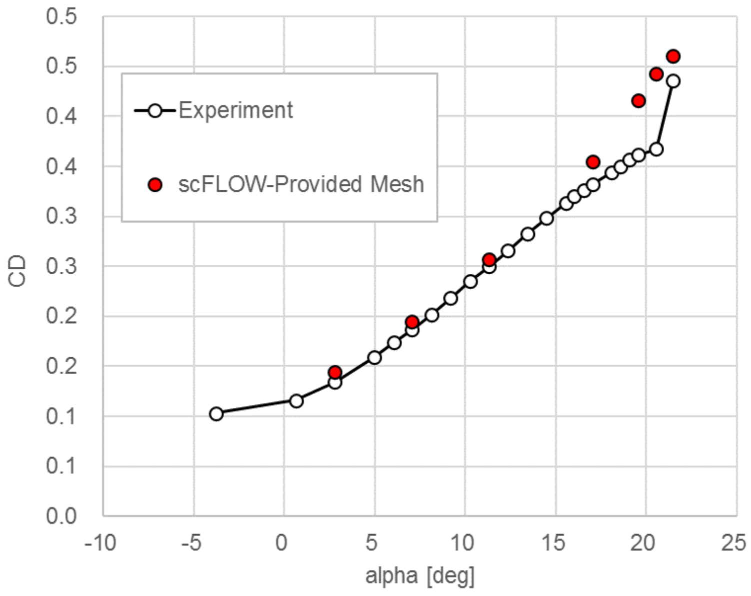
• Mesh	HLPW-4_CRM-HL_40-37_Nominal_v1a_Unstr-Hex-Prism-Pyr-Tet_Level_A_PW_v2
• Total elements	21,868,681
• Total nodes	12,332,217
• Hexahedra	9,441,360
• Tetrahedra	9,428,180
• Prisms	834,536
• Pyramids	21,164,605
• Attack of angle [deg]	2.78, 7.05, 11.29, 17.05, 19.57, 20.55, 21.47
• Calculate mode	Steady State
• Calculate cycles	20000

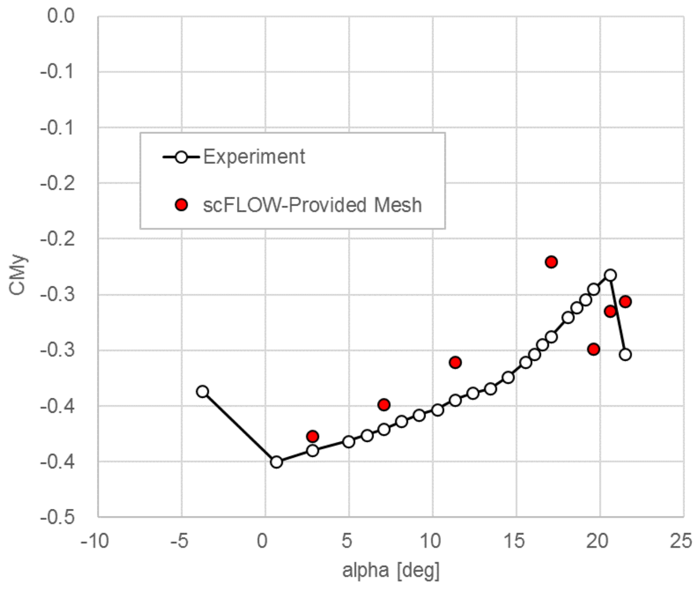
Result of mesh adaptation

Aerodynamics coefficients

- Lift, drag, and momentum coefficients
- Forces and moments Average for last 1000 cycles





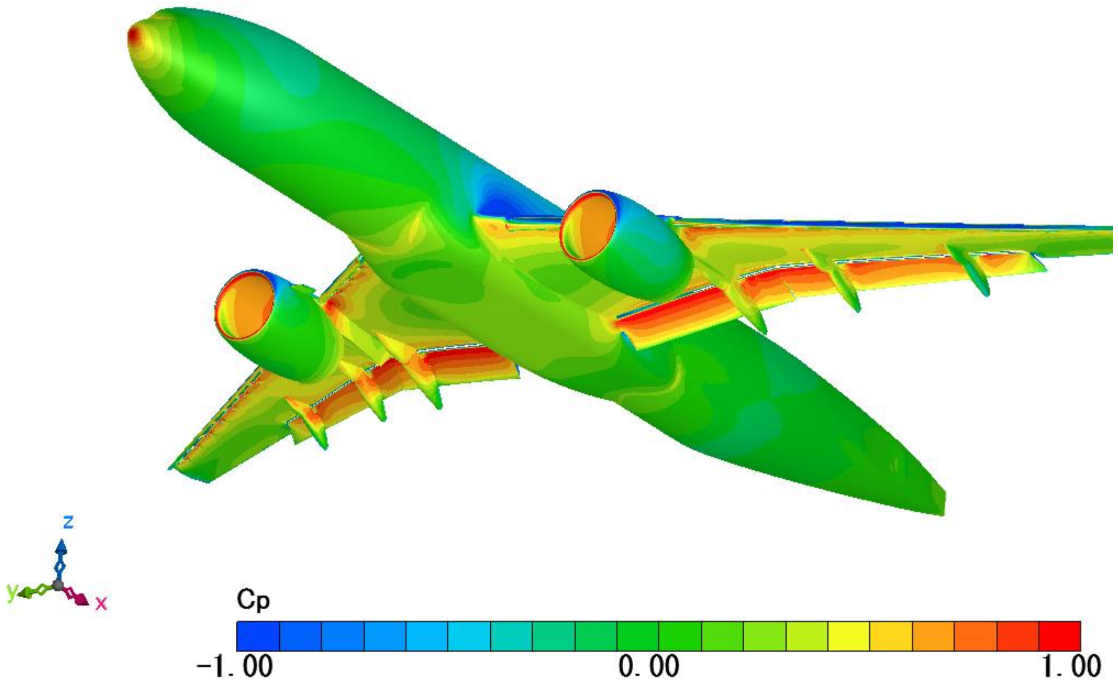


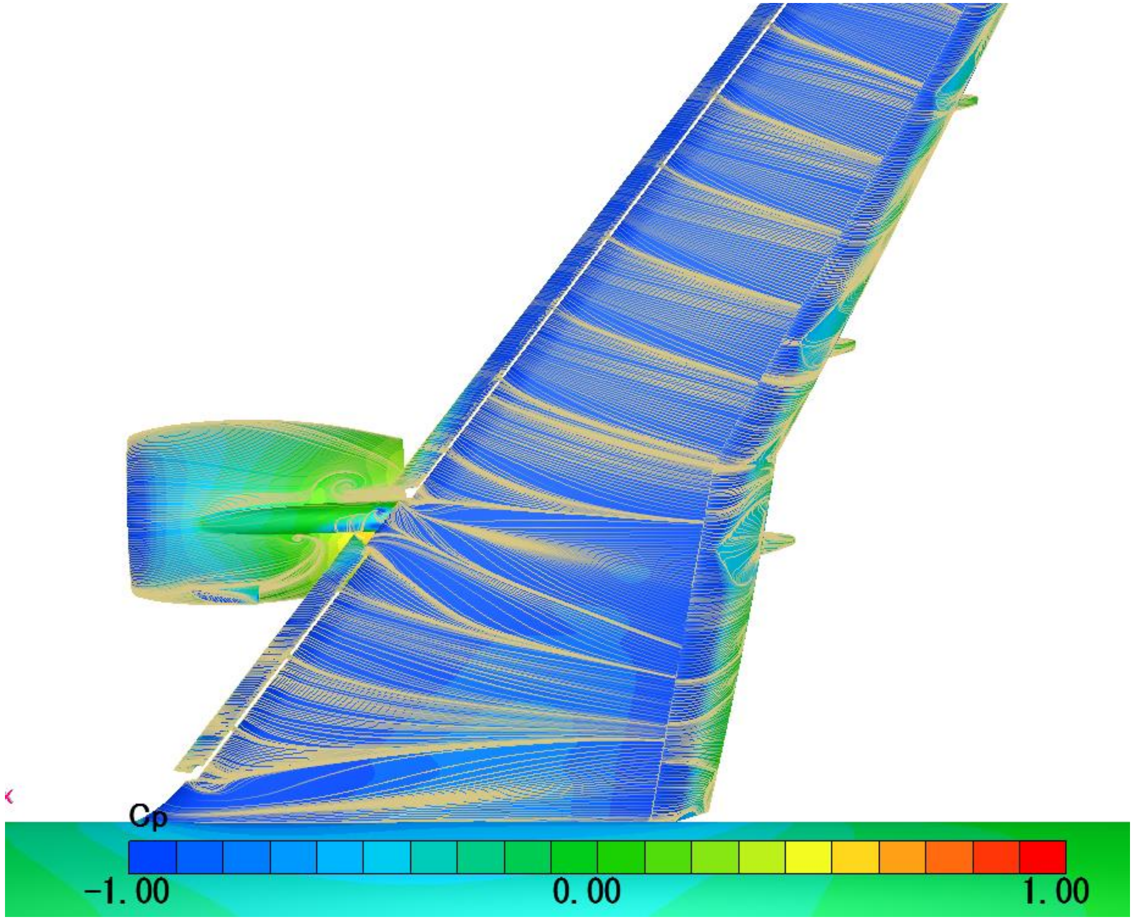
HEXAGON Cradle

Result of mesh adaptation

Aerodynamics coefficients

The surface pressure coefficient and oil flow (α = 7.05[deg])





Conclusion

Current progress and future works

- Current progress
  - We calculated the change in performance due to the angle of attack using the provided mesh.
  - In the angle of attack is small, the results close to the experimental results were obtained.

- Future works
  - We create a polyhedral mesh and compare it with the provided mesh and experimental results.