Numerical analyses for CFD workshops

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● **Abstract**

APC-8 was held to investigate the aerodynamic characteristics of the NASA Common Research Model High-Lift (CRM-HL) configuration. We calculated the CRM-HL characteristics with RANS/URANS and confirmed the data superiority of warm start.

Ref. URL: https://www.aero.jaxa.jp/research/basic/numerical/

● **Reasons and benefits of using JAXA Supercomputer System**

For CFD workshops, it is necessary to use JAXA's supercomputers to perform a large number of calculations of three-dimensional complex shapes to achieve high accuracy.

● **Achievements of the Year**

For the NASA Common Research Model High-Lift geometry (Figure 1), sensitivity to the turbulence model (Figure 2), grid resolution and cold vs hot restart were investigated to select the RANS simulation best-practices. CLmax was successfully predicted (Figure 3), but the wing separation detection needs to be improved (i.e. wind tunnel wall effects, high fidelity simulation)
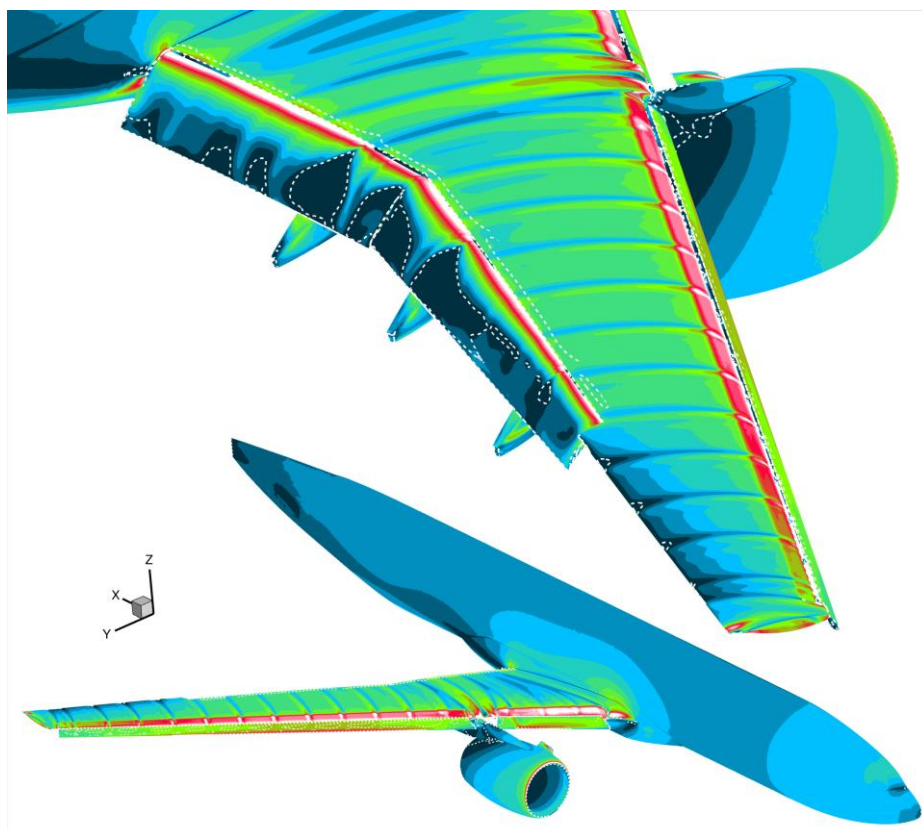
Fig. 1: NASA CRM-HL RANS analysis (7 degrees attack of angle). Surface skin friction coefficient (Cf) distribution, where separation is indicated by the white dashed line.
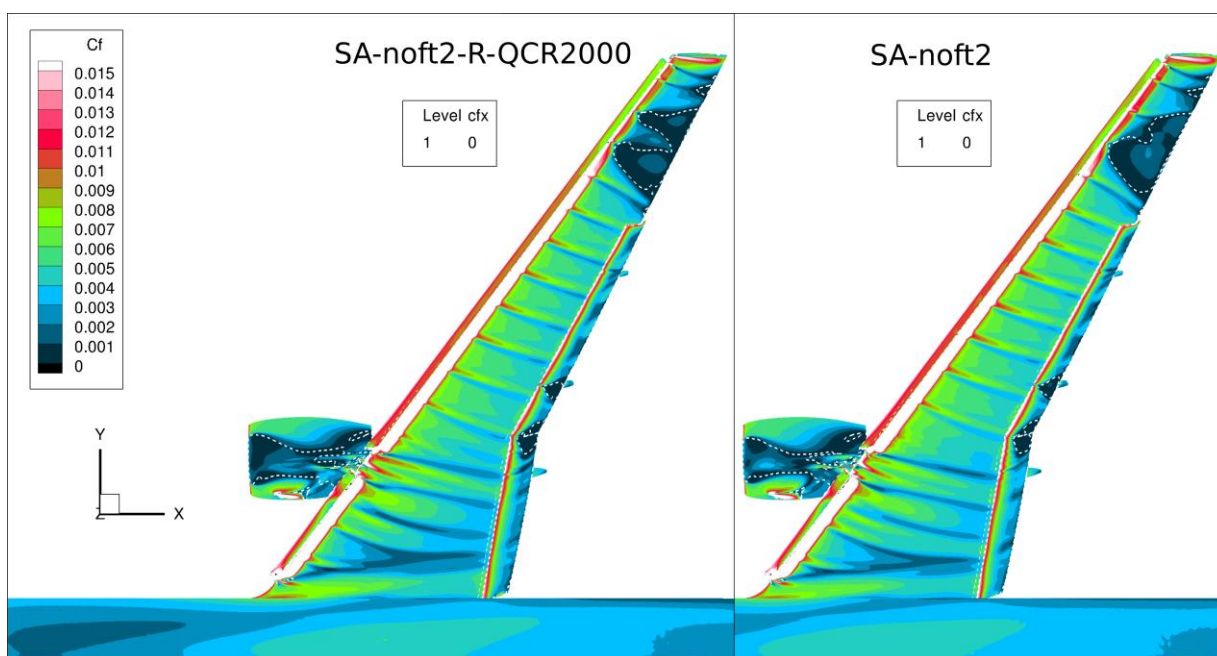

Fig. 2: Sensitivity analysis of RANS turbulence model (angle of attack 17 degrees). Surface skin friction coefficient (Cf) distribution.
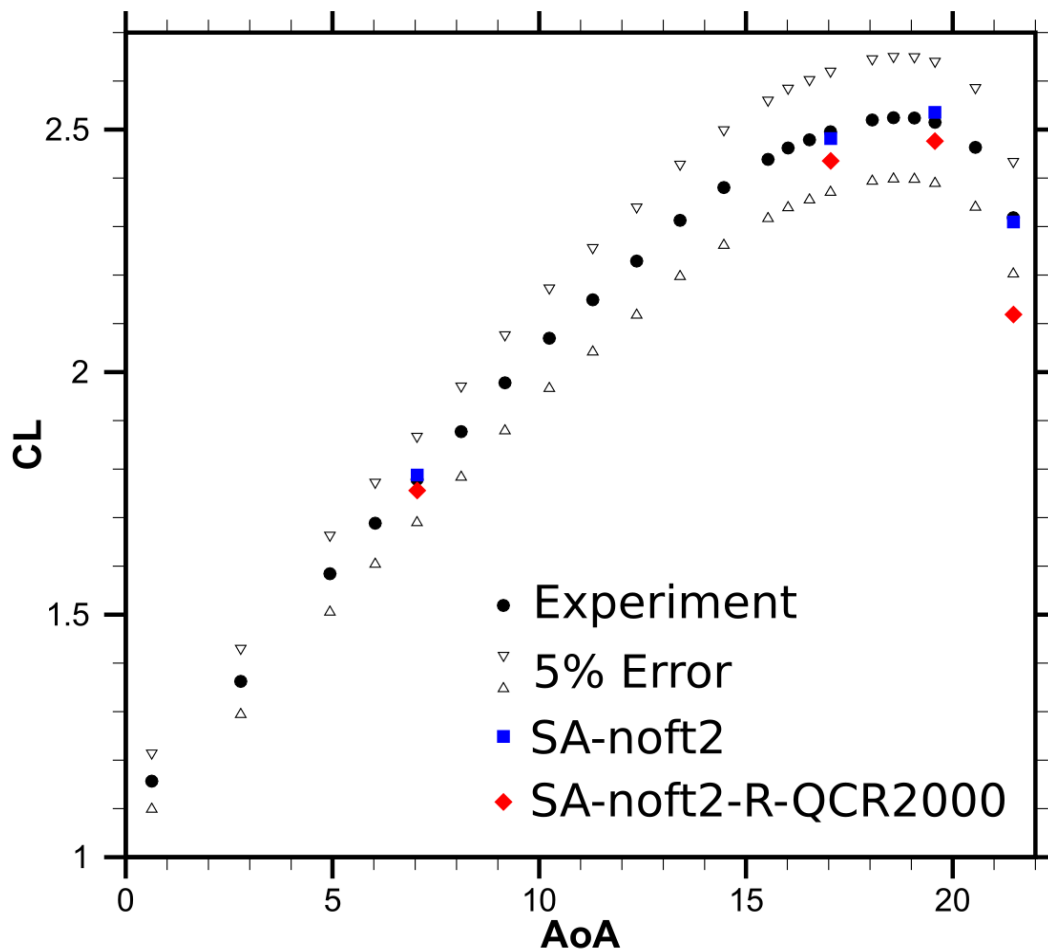
Fig. 3: Lift coefficient as a function of angle of attack. Experimental (black) and RANS results (turbulence model sensitivity: blue = SA-noft2, red = SA-noft2-R-QCR2000). Triangles are 5% error relative to experimental results.

● **Publications**

- Non peer-reviewed papers

[1] M. Zauner, Y. Kojima, A. Sansica, K. Hayashi, and A. Hashimoto, "Eighth Aerodynamic Prediction Challenge (APC-8): Scale-resolving simulations of the CRM high-lift configuration at high angles of attack.", in JAXA-SP-22-003 2022, http://id.nii.ac.jp/1696/00048995/

[2] M. Zauner, A. Sansica, Y. Kojima, D.J. Lusher and A. Hashimoto, "RANS Sensitivity Study and Global Stability Analysis of the NASA Common Research Model High-Lift Configuration", AIAA SciTech 2023, https://doi.org/10.2514/6.2023-1568

- Oral Presentations

[1] M. Zauner, Y. Kojima, A. Sansica, K. Hayashi, and A. Hashimoto,"Scale-resolving simulations of the CRM high-lift configuration at high angles of attack.", 54th Fluid Dynamics Conference / the 40th Aerospace Numerical Simulation Symposium, Morioka, Japan, June 2022

[2] M. Zauner, A. Sansica, Y. Kojima, D.J. Lusher and A. Hashimoto,"RANS Sensitivity Study and Global Stability Analysis of the NASA Common Research Model High-Lift Configuration", AIAA SciTech 2023, https://doi.org/10.2514/6.2023-1568

● **Usage of JSS**

●   **Computational Information**

Process Parallelization Methods	MPI
Thread Parallelization Methods	N/A
Number of Processes	480 - 2304
Elapsed Time per Case	200 Hour(s)

● **JSS3 Resources Used**

Fraction of Usage in Total Resources[*1](%): 0.64

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	16,859,099.44	0.74
TOKI-ST	59,701.63	0.06
TOKI-GP	11,226.07	0.48
TOKI-XM	306.71	0.19
TOKI-LM	10,314.03	0.69
TOKI-TST	0.00	0.00
TOKI-TGP	0.00	0.00
TOKI-TLM	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage[*2] (%)
/home	414.78	0.38
/data and /data2	44,393.33	0.34
/ssd	1,457.56	0.20

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[*2] (%)
J-SPACE	36.16	0.16

[*1]: Fraction of Usage in Total Resources: Weighted average of three resource types (Computing, File System, and Archiver).

[*2]: Fraction of Usage：Percentage of usage relative to each resource used in one year.

● **ISV Software Licenses Used**

ISV Software Licenses Resources		
	ISV Software Licenses Used (Hours)	Fraction of Usage[*2] (%)
ISV Software Licenses (Total)	1,738.59	1.21

[*2]: Fraction of Usage：Percentage of usage relative to each resource used in one year.