The study on improvement of DES method on low-speed buffet phenomenon

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Abstract

A high-resolution, Delayed DES has been conducted around whole the aircraft under the low-speed buffet condition. This numerical case is known as a tough problem, since it is difficult to obtain good numerical solutions that agree well with the corresponding experimental data. In this study, we performed a combined calculation of HR-DDES and HR-SLAU2 with higher resolution and compared it with the conventional method. Its effect has been confirmed by the numerical test.

Reasons and benefits of using JAXA Supercomputer System

1) Expensive, unsteady CFD around whole the aircraft; 2) Many numerical cases (aerodynamic problems) in which our proposed schemes are verified.

Achievements of the Year

Focusing on the position of the separation area and the wing cross-sectional velocity, we compared the calculated and experimental results of the high-resolution method (HR-SLAU2 & HR-DDES) and the conventional methods (HR-SLAU2 & SA-DDES, SLAU2 & SA-DDES). The high-resolution method was closer to the experimental results than the conventional method in terms of the location of the separation area, which was located on the wing tip side. The visualization results of the wing cross-sectional velocity show that the wake passes through the underside of the tail plane in the high-resolution method, which is consistent with the experimental results.

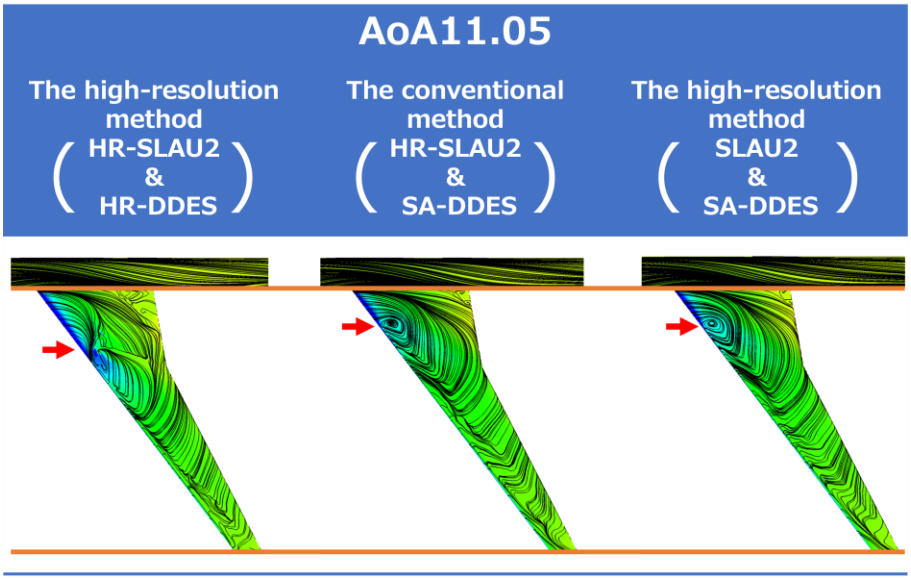

Fig. 1: Comparison of separation area (AoA13.08)

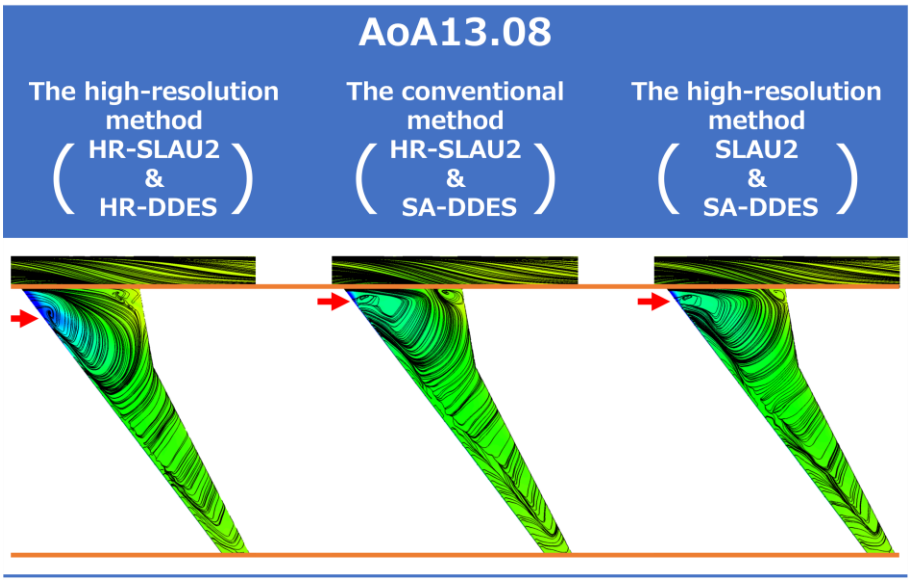

Fig. 2: Comparison of separation area (AoA11.05)

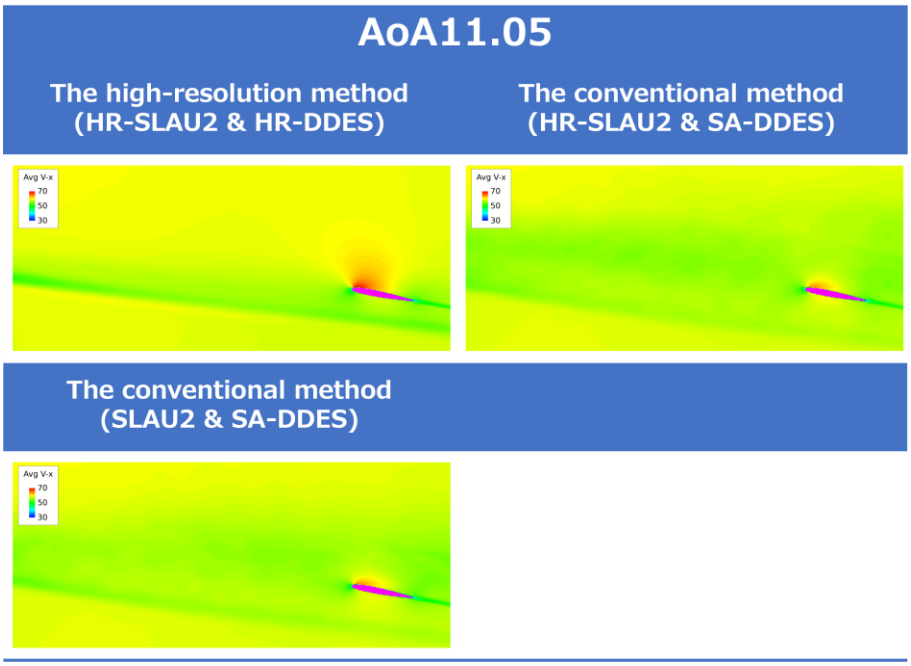

Fig. 3: Comparison of wing cross-sectional velocity (AoA11.05)

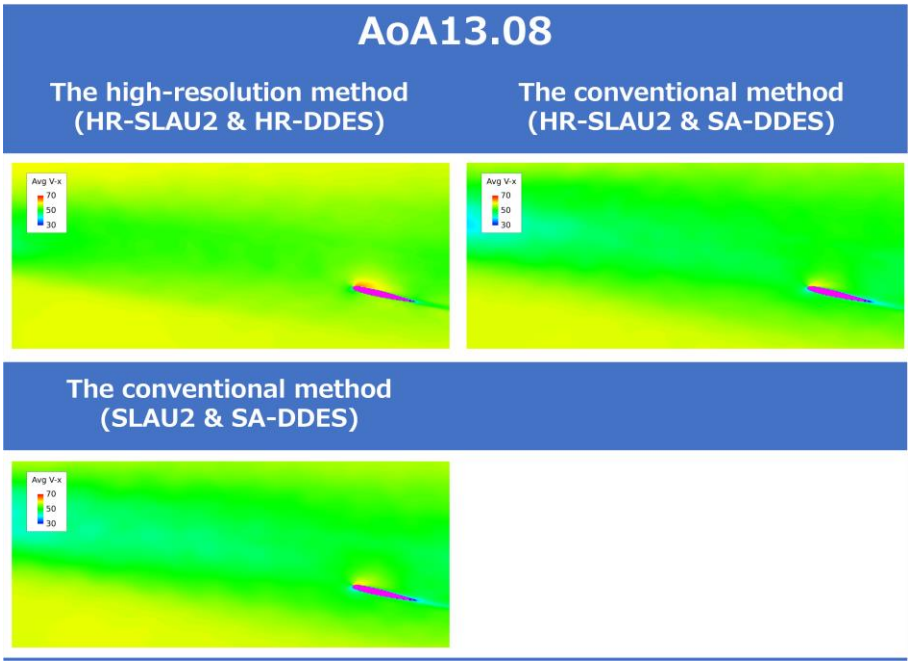

Fig. 4: Comparison of wing cross-sectional velocity (AoA13.08)

Publications

- Oral Presentations

Y. Yasumura, K. Kitamura, Y. Furusawa, M. Kanamori, A. Hashimoto : Comparison of Turbulent Model and Numerical Flux Function on Unsteady NASA CRM Low-Speed Buffet Simulations, 53rd Fluid Dynamics Conference / the 39th Aerospace Numerical Simulation Symposium Seventh Aerodynamics Prediction Challenge (APC-7), 1A20, 30 June 2021.]

Usage of JSS

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	OpenMP
Number of Processes	512
Elapsed Time per Case	50 Hour(s)

JSS3 Resources Used

Fraction of Usage in Total Resources[*1](%): 0.63

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	12,423,177.23	0.60
TOKI-ST	223,289.22	0.28
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	147,077.26	10.96
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	1,999.83	1.99
/data and /data2	207,478.95	2.22
/ssd	6,057.76	1.56

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2(%)
J-SPACE	60.90	0.41

*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)	7,569.15	5.30

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