Numerical study on low-speed buffet

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Abstract

It is of a great importance to predict a so-called low-speed buffet phenomenon for realizing safer flight. During a flight with a high angle-of-attack condition in a low-speed regime, separated flow at a leading edge of main wing impinges on its tail, resulting in a hazardous vibration. Our research group works on a preliminary study on low-speed buffet by means of computational fluid dynamics (CFD) in order to grasp the essence of the phenomenon.

Reasons for using JSS2

It is absolutely necessary to prepare a computational grid with high-resolution near the separated zone in order to predict a low-speed buffet phenomenon accurately. The number of grid point is of the order of tens of millions, which is prohibitively large from a view point of a computation with a personal computer. The processing capability of JSS2 is therefore necessary for our research.

Achievements of the Year

We have computed aerodynamics on NASA Common Research Model (CRM) with support device (Fig. 1).

A good agreement was found in the IDDES analysis using the SST model in terms of the lift coefficient at each angle of attack compared with the experimental values[Uchiyama et al., AIAA 10.2514/6.2019-2190, 2019] (Fig. 2).We focused on the RMS value of the pressure coefficient in the analysis result. The angle of attack changes from 11.5 [deg] to 12.0 [deg] and behaves largely differently on the upper surface of the main wing. At the same time as the change, the differences became larger on the upper surface of the tail mainly at the tip of the tail (Fig. 3, Fig. 4).

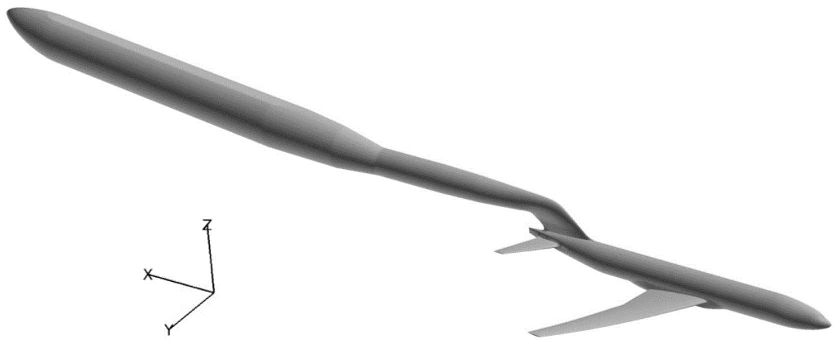

Fig. 1: CFD model of CRM

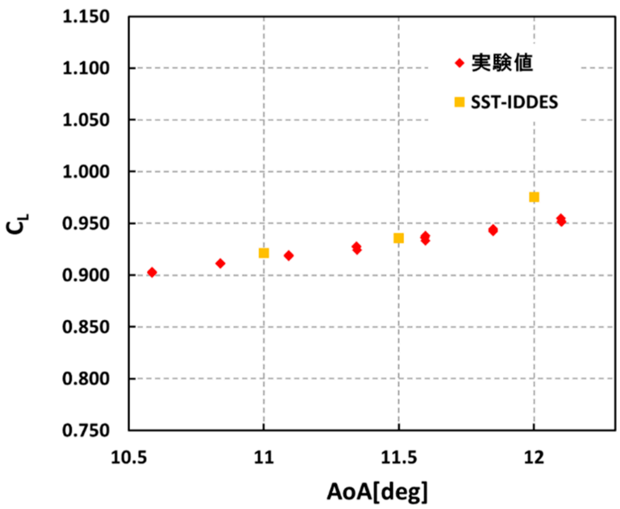

Fig. 2: variation of lift coeficient against angle of attack

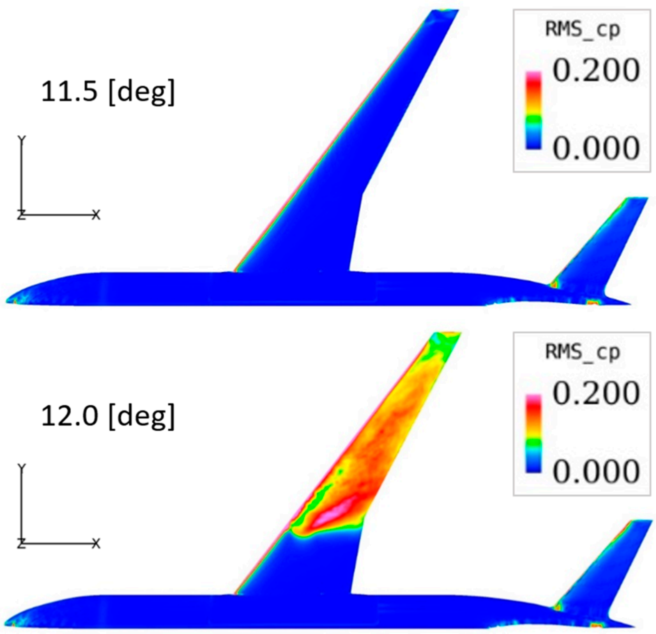

Fig. 3: pressure coeficient RMS on the upper surface of the wing

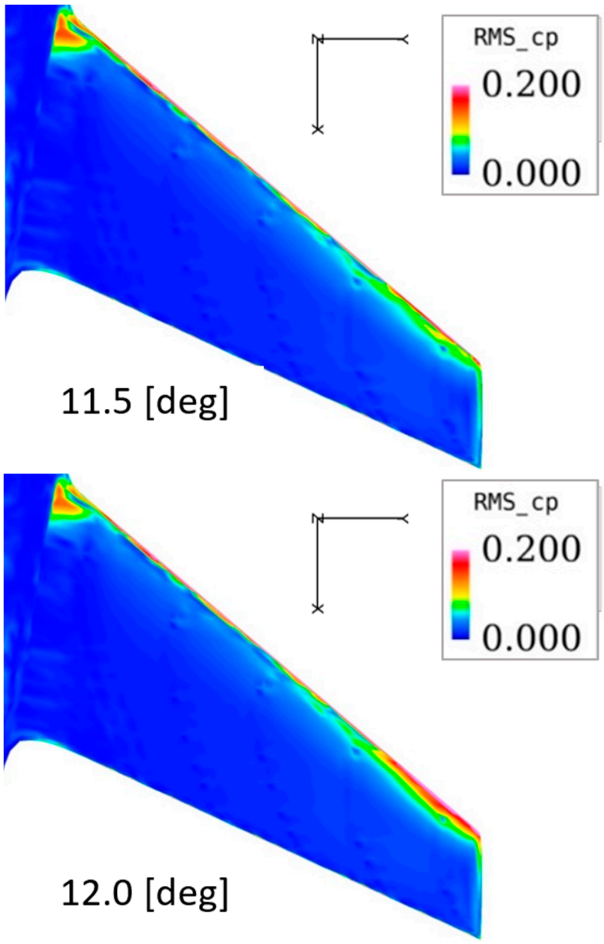

Fig. 4: pressure coeficient RMS on the upper surface of the tail

Publications

- Oral Presentations

T. Yoshikawa, M. Kanamori, Y. Inada, “Numerical study on Numerical study on influence of wake on tailplane under low-speed buffet conditions”, The 56th Aircraft Symposium, 2018

Usage of JSS2

- **Computational Information**

Process Parallelization Methods	MPI
Thread Parallelization Methods	N/A
Number of Processes	480
Elapsed Time per Case	170 Hour (s)

- **Resources Used**

Fraction of Usage in Total Resources*1 (%): 0.38

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage*2 (%)
SORA-MA	3,381,372.13	0.41
SORA-PP	6,705.34	0.05
SORA-LM	3,099.24	1.44
SORA-TPP	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage*2 (%)
/home	476.84	0.49
/data	9,765.63	0.17
/ltmp	1,953.13	0.17

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2 (%)
J-SPACE	0.00	0.00

*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.