Studies on real flight aerodynamic prediction

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● Abstract

Through a series of aerodynamic design sequence in the aircraft development, we aim to speed up that sequence by cutting-edge technologies which enable us to avoid from the delay of the development and speed-up the aerodynamic sequence.

By applying the sophisticated data analysis techniques to high-speed buffet data produced by unsteady CFD, a technology to detecting the sign and location of buffet phenomena is developped. An analysis to replicate Reyunolds number effect appeared on aerodynamic characteristics is also conducted to develop the future real flight aerodynamic prediction .

● Reasons for using of JSS2

A huge parallel computar like JSS2 is required to carry out large-scale analysis for unsteady buffet phenomena and high precision computations for evaluating the Reynolds number effect.

● Achievements of the Year

For the research of beffet onset detection, unsteady CFD calculation introducing DES was applied to 2-dimensinal NACA0012 airfoil at M=0.72 and AOA=3 to 6 degree. (Fig. 1) The buffet onset was detected from the unsteady CFD results by the conventional method using CLrms. (Fig. 2) The unsteady CFD results was also used for the develpment of new buffet onset detection techniques using data-mining methods.

The Reynolds number research was conducted using the airfoil of the C-141 aircraft, which was

occurred a problem due to Reynolds number effect. The   Reynolds number effect of C-141 airfoil was evaluated in wide range of Reynolds number variations. (Fig.3)
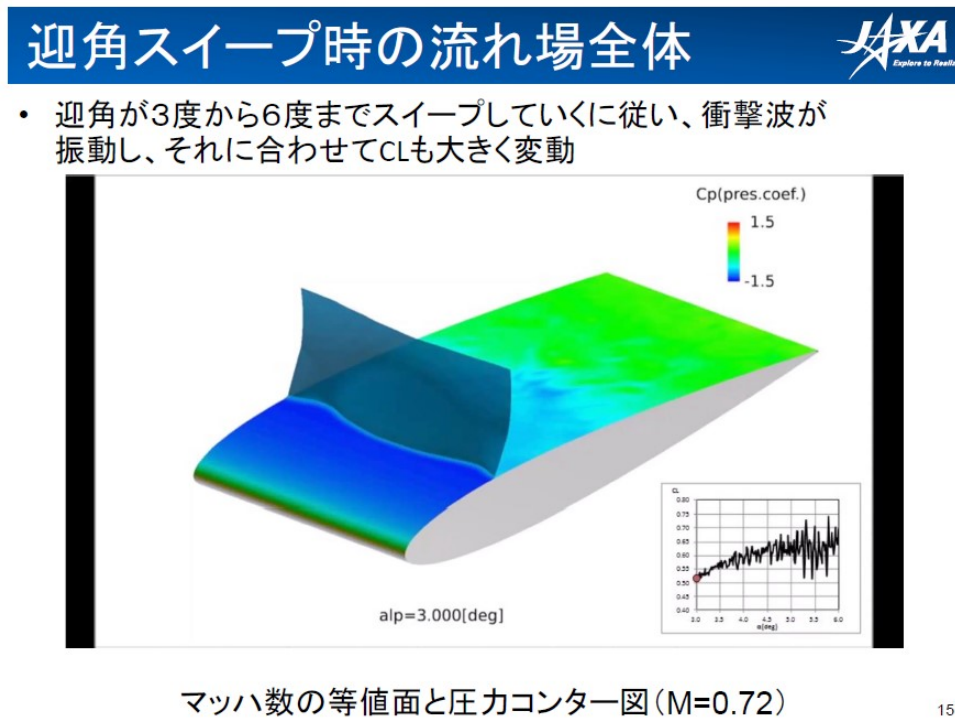

Fig.1 Pressure distribution including shock-wave location on a NACA0012 airfoil at M=0.72 and AoA=3deg.
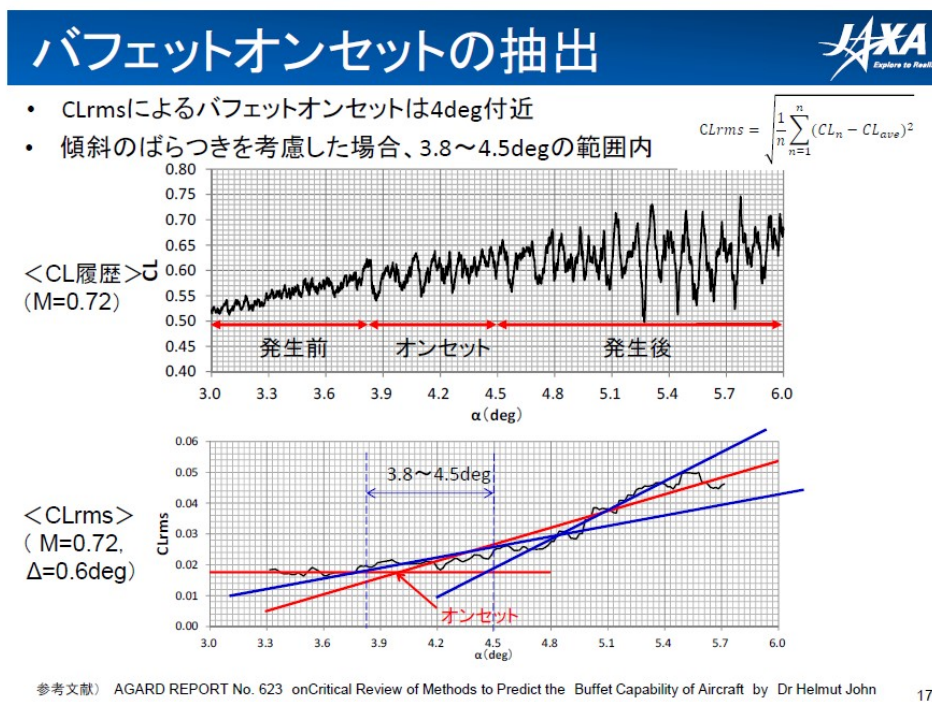

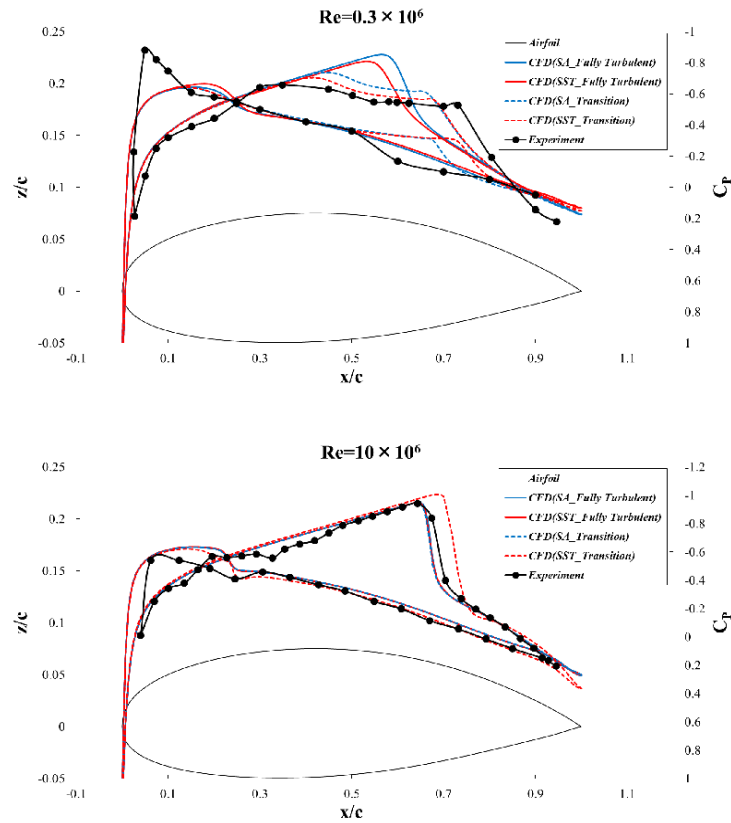Fig.2 Detection of the starting point of buffet phenomen using CLrms from unsteady CFD results

Fig.3 Pressure distribution around a quasi 2-dimensional C-141 airfoil employing transition model for turbulence modeling.

Publications

● Peer-reviewed papers

1) Yamazaki, W., Yamagishi, S., and Ueno, M,.   "Investigation of Indirect Reynolds Number Effect via Computational Fluid Dynamics Simulations", Journal of Aircraft, Posted online on 30 Jan 2018.

● Non peer-reviewed papers

1) Kazuhisa Chiba, Yuhei Umeda, Naoki Hamada, Shinya Watanabe, Masaya Nakata, Kanako Yasue, Koji Suzuki, Takashi Atobe, Shigeru Kuchi-Ishi, Kazuyuki Nakakita, Takeshi Ito, Determination of Temporal and Spatial Origination of Transonic Buffet via Unsteady Data Mining, AIAA 2018-0036, 2018 AIAA Aerospace Sciences Meeting, 2018.

2) Yamazaki, W, Yamagishi, W and Ueno, M., "Investigation of Indirect Reynolds Number Effect via Computational Fluid Dynamics Simulations," 35th AIAA Applied Aerodynamics Conference, AIAA 2017-3404, 2017.

3) Yamazaki, W, Yamagishi, W and Ueno, M., "Investigation of Indirect Reynolds Number Effect of C-141 Aircraft Model," Proceedings of the Fourteenth International Conference on Fluid Dynamics, 2017.

🔵 Usage of JSS2

● Computational Information

Parallelization Methods	MPI
Thread Parallelization Methods	N/A
Number of Processes	128 - 512
Elapsed Time per Case	720.00 hours

● Resources Used

Fraction of Usage in Total Resources*1 (%): 1.92

Details

Computing Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage*2 (%)
SORA-MA	15,973,279.51	2.13
SORA-PP	12,985.28	0.16
SORA-LM	313.00	0.16
SORA-TPP	0.00	0.00

File System Resources		
File System Name	Storage assigned(GiB)	Fraction of Usage*2 (%)
/home	130.33	0.09
/data	25,241.03	0.47
/ltmp	8,191.38	0.62

Archiver Resources		
Archiver System Name	Storage used(TiB)	Fraction of Usage*2 (%)
J-SPACE	5.27	0.23

*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