Aerodynamic Simulations on Airframe Noise Reduction Technology (FQUROH-A)

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Abstract

In order to meet the projected demand for air passengers, and to strengthen the international competitiveness of Japan airports and improve the convenience of passengers, major airports are considering increasing the number of takeoffs and landings. The maturity of the technology for the reduction of airframe noise generated at high-lift devices and landing gear needs to be increased to achieve noise reduction in areas surrounding airports even with the expected increased number of takeoffs and landings. In this project, we have been developing a flight test plan using a commercial airplane that demonstrates the reduction of airframe noise as part of activities aimed at practical development of the airframe noise reduction technology. Computational simulations have been utilized to verify the feasibility of practical noise reduction concepts and design methods. This computational activity focuses on the evaluation of noise reduction concepts applied to an airplane by exploring their aerodynamic impacts to the performance of the airplane.

Ref. URL: http://www.aero.jaxa.jp/eng/research/ecat/fquroh/

Reasons and benefits of using JAXA Supercomputer System

The JSS3 enabled a large number of high-fidelity Reynolds-averaged Navier-Stokes (RANS) simulations with aerodynamically-important details in several flight configurations in the expected flight envelop to be conducted in a timely manner. The aerodynamic effect of low-noise devices can be evaluated and quantified, which is difficult to obtain only with wind tunnel tests.

Achievements of the Year

Aerodynamic simulations by RANS CFD have been conducted for the JAXA airframe noise research model OTOMO2 with the leading-edge slat and trailing-edge flap deployed as shown in Fig.1. During the design process of the noise reduction devices for the leading-edge slats, sensitivities of slat settings to the flowfields and aerodynamic performance have been investigated (Fig.2). Computational simulations have been also conducted to evaluate the impact of the low-noise devices on flowfields and aerodynamic performance of the aircraft model to ensure that the devices are effective in noise reduction and have a small impact on aerodynamics.

Fig. 1: Airframe noise research model in a high-lift configuration with the leading-edge slat and trailing-edge flap deployed, OTOMO2

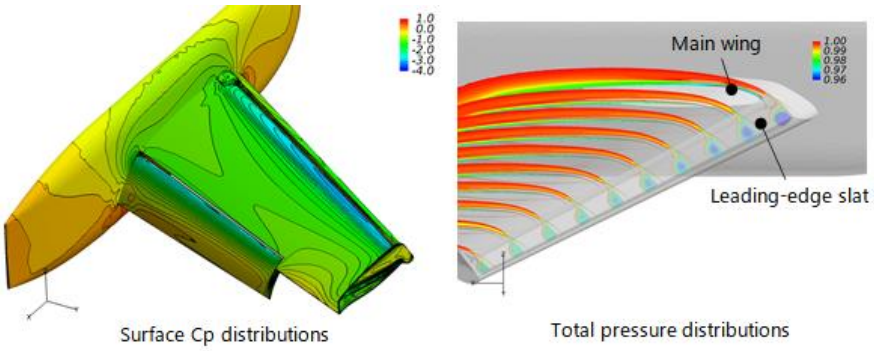

Fig. 2: Surface Cp and total pressure distributions around OTOMO2 model

Publications

N/A

Usage of JSS

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	OpenMP
Number of Processes	128 - 192
Elapsed Time per Case	10 Hour(s)

- **JSS3 Resources Used**

Fraction of Usage in Total Resources[*1](%): 0.54

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	12,900,924.73	0.63
TOKI-ST	3,068.65	0.00
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	32.52	0.00
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	69.00	0.07
/data and /data2	7,363.92	0.08
/ssd	579.48	0.15

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[*2](%)
J-SPACE	439.54	2.97

[*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)	238.43	0.17

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