Aerodynamic Simulations on Airframe Noise Reduction Technology (FQUROH-2)

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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

In addition to demonstrating noise reduction concepts applied to a commercial airplane in a flight test, the same noise reduction concepts will be applied to a common high-lift research model (CRM-HL) to evaluate their

generality in this research project. Reynolds averaged Navier-Stokes (RANS) simulations have been conducted for the design of high-lift device layout of a wind tunnel model of the CRM-HL. In-tunnel simulations have also been conducted to understand the flow around the CRM-HL in a wind tunnel to set basic specifications of the wind tunnel model.

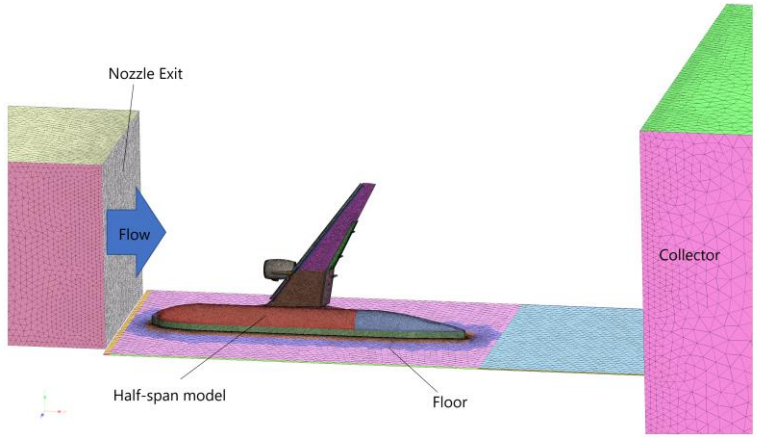

Fig. 1: Computational grid for in-tunnel RANS simulations to check feasibility of far-field noise measurements

Publications

- Peer-reviewed papers

Ito, Y., Murayama, M., Yokokawa, Y., Yamamoto, K., Tanaka, K., and Hirai, T., "Wind Tunnel Installation Effects on Japan Aerospace Exploration Agency's Standard Model," Journal of Aircraft, Vol. 59, No. 5, September 2022, pp. 1281-1302, DOI: 10.2514/1.C036741.

Usage of JSS

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	OpenMP
Number of Processes	128 - 600
Elapsed Time per Case	11.3 Hour(s)

- **JSS3 Resources Used**

Fraction of Usage in Total Resources[*1](%): 0.19

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	5,080,147.91	0.22
TOKI-ST	6,576.02	0.01
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	0.00	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	55.13	0.05
/data and /data2	6,206.35	0.05
/ssd	496.59	0.07

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[*2] (%)
J-SPACE	466.64	2.07

[*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)	348.75	0.24

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