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

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Abstract

In order to meet the projected demand for air travel, strengthen the international competitiveness of Japan's airports, and improve passenger convenience, major airports are considering increasing the number of takeoffs and landings. To achieve noise reduction in the areas surrounding airports even with the expected increase in the number of takeoffs and landings, it is necessary to increase the maturity of the technology for reducing airframe noise generated by high-lift devices and landing gear. In this project, we have developed a flight test plan using a commercial aircraft to demonstrate airframe noise reduction as part of activities aimed at practical development of airframe noise reduction technology. Computational simulations were used to verify the feasibility of practical noise reduction concepts and design methods. This computational activity focuses on evaluating noise reduction concepts applied to an aircraft by studying their aerodynamic effects on aircraft performance.

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

Reasons and benefits of using JAXA Supercomputer System

The JSS3 allowed a large number of high-fidelity Reynolds-averaged Navier-Stokes (RANS) simulations with aerodynamically important details to be performed in multiple flight configurations in the expected flight envelope in a timely manner. The aerodynamic effect of low-noise devices can be evaluated and quantified, which is difficult to achieve with wind tunnel testing alone.

Achievements of the Year

In addition to the flight demonstration of the aircraft noise reduction technology developed in this project on a passenger aircraft, the project plans to apply the same technology to a standard high-lift configuration model representing the latest passenger aircraft geometry (High-Lift Common Research Model - CRM-HL; Fig. 1) and

evaluate the amount of noise reduction to demonstrate the effectiveness of the technology on a common aircraft configuration. Reynolds-averaged Navier-Stokes (RANS) simulations were performed this fiscal year to determine the specifications for the design and fabrication of a CRM-HL wind tunnel test model, including the layout design of the high-lift device, and the design of the wind tunnel test model was successfully initiated as planned. In order to validate the RANS solver, RANS simulations were also conducted to address issues compiled from a CFD workshop for predicting the aerodynamic characteristics of high-lift devices using the CRM-HL (Fig. 2).

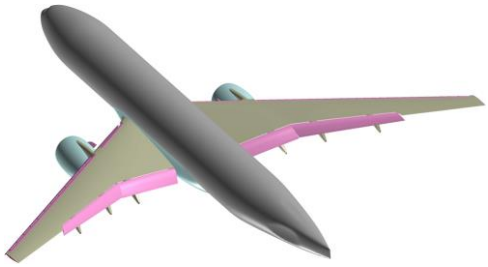

Fig. 1: CRM-HL geometry

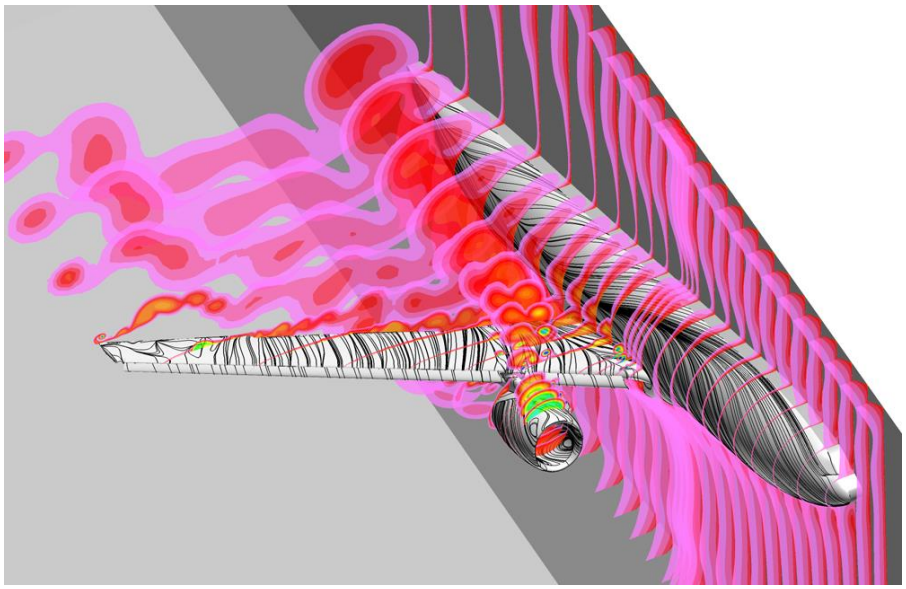

Fig. 2: Total pressure distribution around CRM-HL semi-span model in wind tunnel test section

Publications

N/A

Usage of JSS

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	OpenMP
Number of Processes	32 - 800
Elapsed Time per Case	11 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	14,663,836.61	0.66
TOKI-ST	2,685.70	0.00
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	55.94	0.05
/data and /data2	9,665.96	0.06
/ssd	669.34	0.06

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2 (%)
J-SPACE	714.27	2.57

*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)	278.85	0.13

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