Environment Conscious Aircraft Systems Research in Eco-wing Technology:Airframe-Engine Noise Reduction Technology

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Abstract

Innovative drag reduction technologies are investigated to reduce the fuel consumption for a conventional aircraft configuration. Aircraft noise prediction technologies and the conceptual design technologies are also developed for future aircraft which achieve low noise and high efficiency.

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

Reasons and benefits of using JAXA Supercomputer System

The JSS2 is used to develop the airframe, engine, and interference noise prediction tools that have high or middle fidelities for applicable to MDO design with high fidelity CFD and FEM analysis. The airframe-engine installation and/or shielding effects are one of important key issues for the future aircraft. The accuracy of current low fidelity analysis for the airframe, engine, and interference noise prediction is not good enough for application to MDO design with high fidelity CFD and FEM analysis toward the future low-noise aircrafts. The JSS2 is required for development of high or middle fidelity noise prediction tools for competitiveness in technology.

Achievements of the Year

A high-fildelity noise propagation prediction method has been developed to simulate engine fan noise shielding effect by airframe. By utilizing linearized Euler equation on Building-Cube Cartesian Grid, the method has several advantages to efficiently simulate the noise propagation around comlicated geometries in the flowfield. The accuracy has been validated and improved through comparison with the wind tunnel test results using a fan noise simulator to investigate the fan noise shielding effect (Fig.1).

In addition, aerodynamic and aeroacoustic performances of a Krueger flap were evaluated. A Krueger flap is a

leading-edge high-lift device which works similarly to a conventional slat but deployed from the lower surface of the leading edge of the wing. In contrast to a conventional slat, a Krueger flap can keep the smoothed upper surface, thus it is considered as a high-lift device for future aircraft with drag reduction technologies associated with laminar flow control. The comparision of unsteady flow simulations around a conventional slat and a Krueger flap indicated a Krueger flap concept that provides comparable aerodynamic performance to a conventional slat with reduced noise levels (Fig.2).

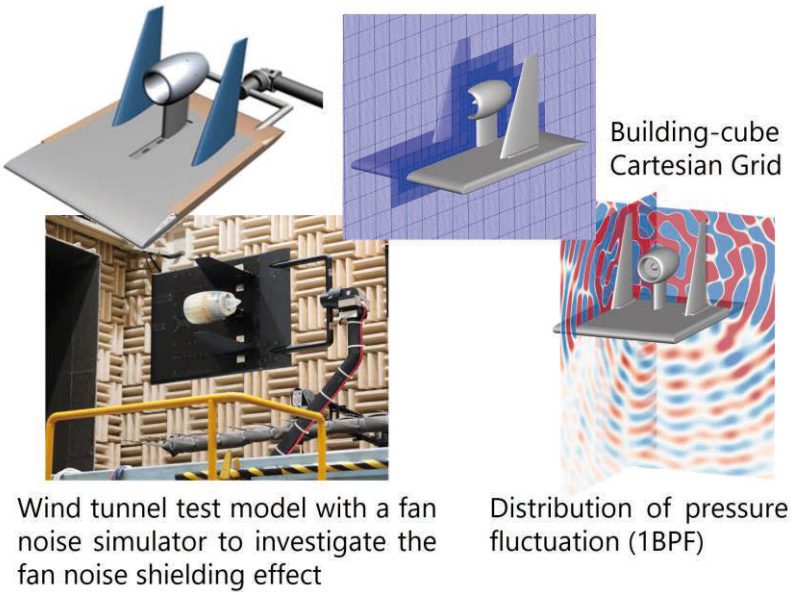

Fig. 1: Fan noise propagation simulation around a wind tunnel test model with a fan noise simulator to investigate the fan noise shielding effect

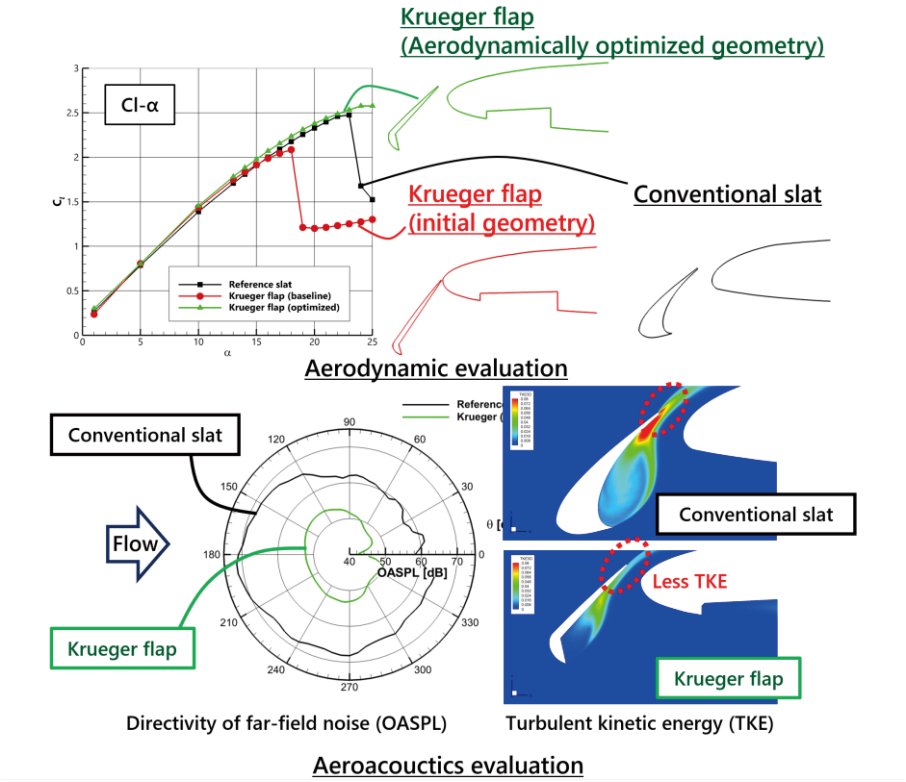

Fig. 2: Comparison of aerodynamic and aeroacoustic computational results around a conventional slat and a Krueger flap

Publications

- Poster Presentations

Usage of JSS2

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	OpenMP
Number of Processes	128 - 1600
Elapsed Time per Case	48 Hour(s)

- **Resources Used**

Fraction of Usage in Total Resources[*1](%): 0.87

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage[*2](%)
SORA-MA	7,624,342.03	0.93
SORA-PP	6,534.87	0.04
SORA-LM	1,050.36	0.44
SORA-TPP	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage*2(%)
/home	242.35	0.20
/data	14,656.28	0.25
/ltmp	4,075.74	0.35

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2(%)
J-SPACE	177.19	4.46

[*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.