Research on Airframe Noise Reduction Design (FQUROH-2)

Report Number: R22EDA101R21
Subject Category: Aeronautical Technology
URL: https://www.jss.jaxa.jp/en/ar/e2022/20799/

Responsible Representative

Takashi Aoyama, Program Director of Aviation Technology, Aviation Technology Directorate

Contact Information

Takehisa Takaishi, FQUROH-2 Pre-Project Team (Airframe Noise Reduction Technology Pre-Project Team), Aviation Technology Directorate(takaishi.takehisa@jaxa.jp)

Members

Takehisa Takaishi, Mitsuhiro Murayama, Yasushi Ito, Ryotaro Sakai, Kazuomi Yamamoto, Kazuki Fukaya, Kentaro Tanaka, Tohru Hirai, Gen Nakano, Takashi Ishida

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 based on Large/Detached Eddy Simulations (LES/DES) is used to understand the mechanism of noise sources, to predict noise levels and to design noise reduction devices.

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

Reasons and benefits of using JAXA Supercomputer System

The JSS3 was used to understand detailed physics of noise generation, and to optimize noise reduction designs. The FQUROH project aims to accelerate technology maturity of airframe noise reduction methods using advanced large-scale, high-fidelity computational simulations on the JSS3's high performance computing platform and to demonstrate the high-fidelity design technologies through flight tests. Computational simulations using the JSS3 made it possible to design low-noise devices by understanding detailed physical phenomena, which was difficult to obtain only with wind tunnel tests.

Achievements of the Year

Unsteady flow simulations with different slat position settings have been conducted to understand flow characteristics and mechanisms of noise generation around leading-edge slats that have been found to be one of major aircraft noise sources during approach. The characteristics of the flow around the slats with slat tracks, and the mechanism of noise generation due to the different slat arrangements were identified. Noise reduction devices for the slats have also been designed. The noise reduction effects were evaluated using unsteady flow simulations by changing cutouts around the leading-edge of the main wing for slat tracks and sectional shapes of the slat tracks.

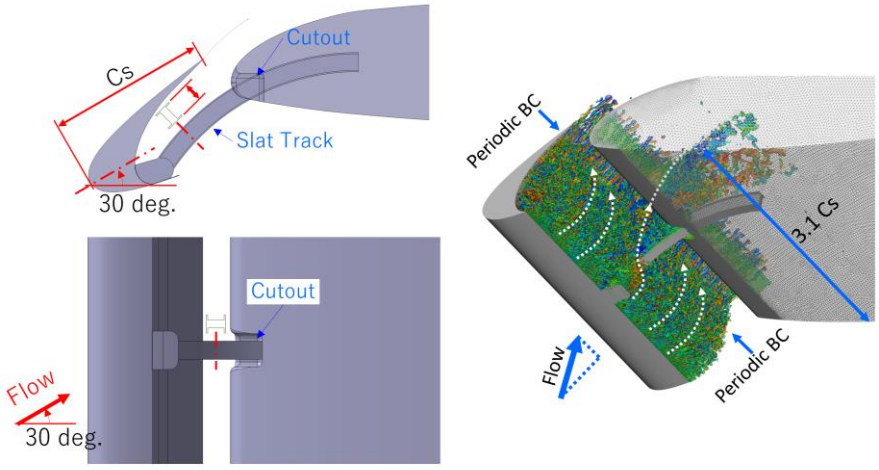

Fig. 1: Research model geometry for the evaluation of noise generation and reduction mechanisms around a leading-edge slat with a slat track

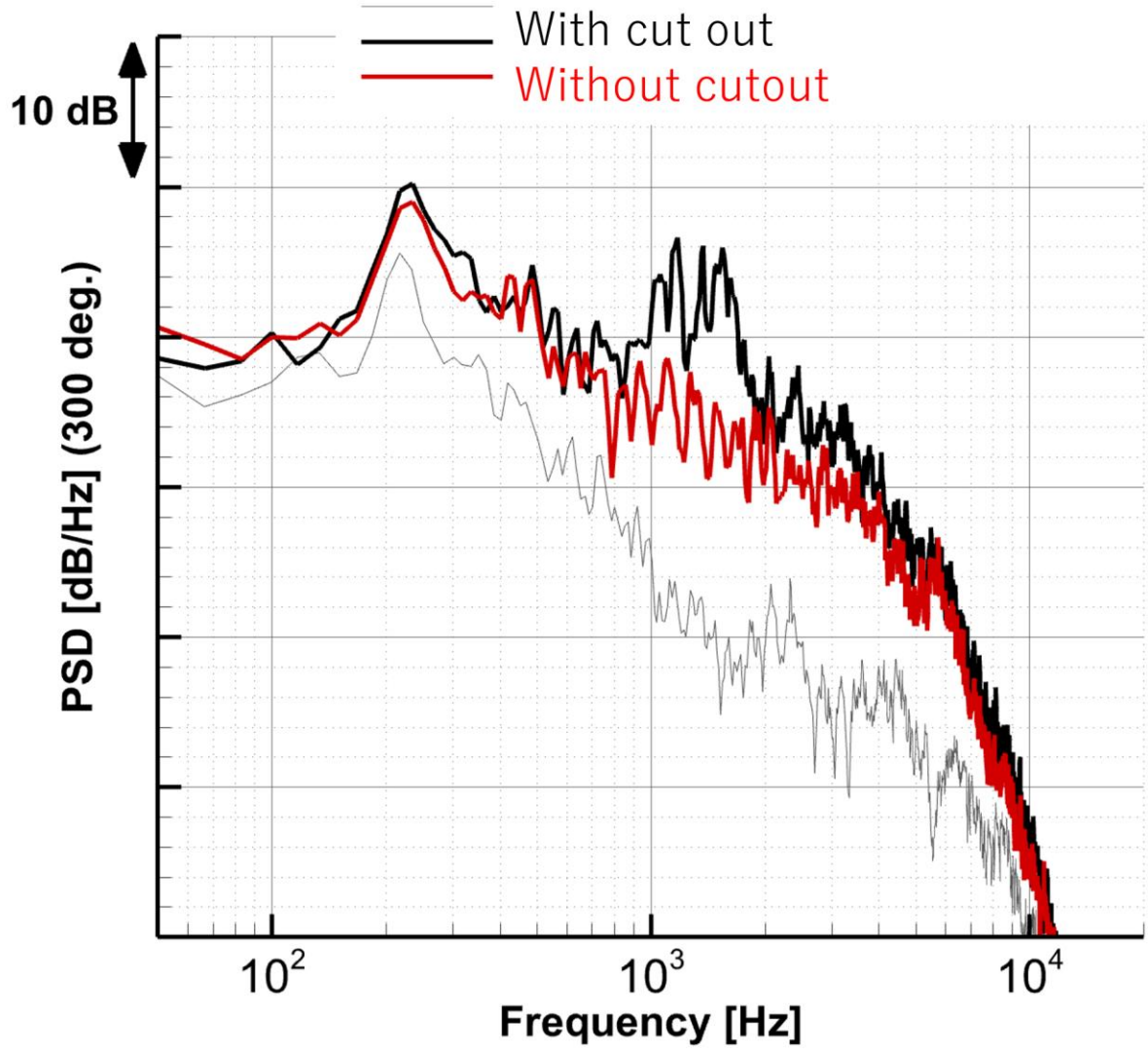

Fig. 2: Change of noise reduction levels with and without a cutout around the leading-edge of the main wing for a slat track

- **Publications**

  N/A

- **Usage of JSS**

- **Computational Information**

Process Parallelization Methods	MPI
Thread Parallelization Methods	N/A
Number of Processes	192 - 256
Elapsed Time per Case	20 Hour(s)

- **JSS3 Resources Used**

Fraction of Usage in Total Resources[*1](%): 0.08

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	764,196.07	0.03
TOKI-ST	447,591.97	0.45
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	436.26	0.03
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	15,422.35	0.12
/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)	163.60	0.11

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