Noise suppression technology for aircraft jet engines

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Abstract

Ultra high bypass ratio aviation jet engines have a smaller sound absorbing liner area than conventional engines. In this project, we will develop sound-absorbing device technology that provides high noise reduction performance even with a small-sized sound-absorbing liner.

Reasons and benefits of using JAXA Supercomputer System

To perform many LES calculations by changing the shape of the sound absorbing liner and the incident sound frequency, the calculation performance and the storage capacity of JAXA supercomputer system were required.

Achievements of the Year

In this research, numerical simulations of phenomena that occur when sound is incident on a sound-absorbing liner used to reduce noise in aircraft jet engines are being conducted. This year, numerical simulation of the impulse response method was attempted, taking advantage of the fact that the phenomenon is linear when sound pressure is not high. Although this simulation is performed in the time domain, the amplitude and phase of the sound pressure in the frequency domain can be easily obtained as a result. The figure shows a moving image of how the amplitude (Figure 1) and phase (Figure 2) of the sound field changes with the frequency of the incident sound when a plane wave sound is incident from left to right with no flow in a flow duct with a single hole sound absorbing liner. This analysis method facilitates understanding of the acoustic phenomena occurring in sound-absorbing liners.

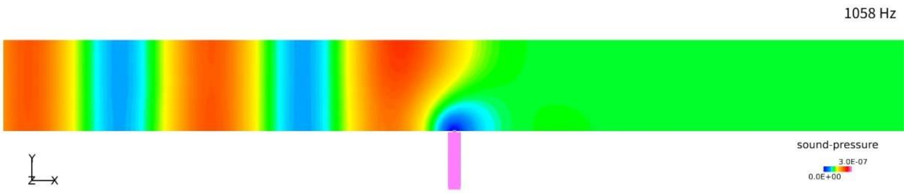

Fig. 1: Amplitude of sound when a plane wave sound is incident on the sound absorbing liner from right to left. (Video. Video is available on the web.)

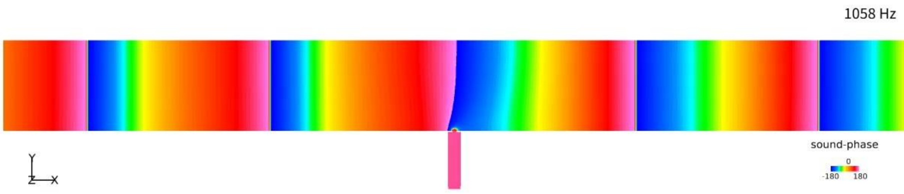

Fig. 2: Phase of sound (Video. Video is available on the web.)

Publications

- Non peer-reviewed papers

Shunji Enomoto, Hideshi Oinuma, Kenichiro Nagai, Junichi Oki, Tatsuya Ishii, Evaluation of Sound Absorption Coefficient Using Impulse Response Method in Numerical Analysis of Sound Absorbing Liners, FDC/ANSS 2022

Usage of JSS

- **Computational Information**

Process Parallelization Methods	MPI
Thread Parallelization Methods	OpenMP
Number of Processes	4 - 160
Elapsed Time per Case	300 Hour(s)

- **JSS3 Resources Used**

Fraction of Usage in Total Resources*1(%): 0.56

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage*2(%)
TOKI-SORA	13,229,403.23	0.64
TOKI-ST	786.08	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	17.03	0.02
/data and /data2	3,816.60	0.04
/ssd	764.73	0.20

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2(%)
J-SPACE	26.93	0.18

*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)	278.63	0.20

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