Acoustic Liner Program for High-bypass-ratio Aircraft engines (acoustic performance improvement)

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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 study, numerical simulations of phenomena that occur when sound is incident on a sound-absorbing liner, which is used to reduce noise in aircraft jet engines, are being conducted. This year, we attempted to simulate sound absorption phenomena by an acoustic liner with multiple resonators. Figure 1 visualizes the sound pressure decrease (sound is blocked) by the acoustic liner when sound is injected from left to right in the absence of grazing flow. Figure 2 shows the phase of sound. A complex sound field is formed by multiple resonators. On the other hand, when a laminar flow with a Mach number of 0.3 was used to simulate the grazing flow over the acoustic liner, the calculation became unstable depending on the calculation conditions because the phenomenon, which should originally be a turbulent flow, was simulated by a laminar flow. For this reason, we changed our approach in the middle of this fiscal year, and used this year as a preparatory period for the development of a new calculation method.

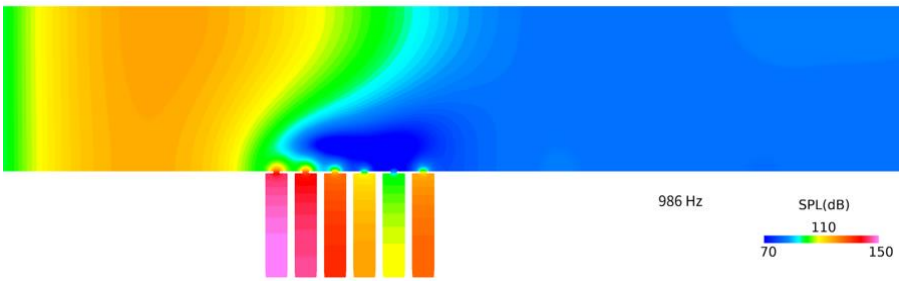

Fig. 1: Sound Pressure (dB)

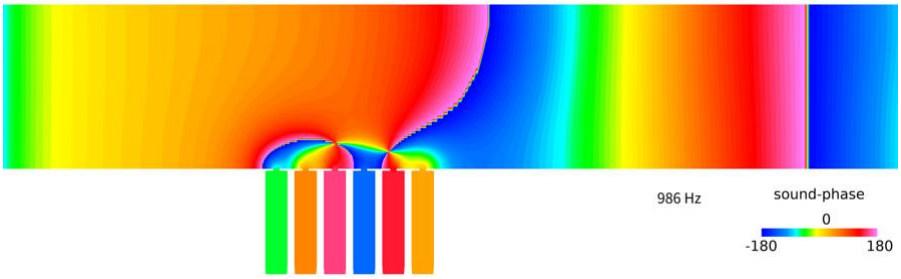

Fig. 2: Sound Pressure (phase)

Publications

- Non peer-reviewed papers

Shunji ENOMOTO, Hideshi OINUMA, Kenichiro NAGAI, Junichi OKI, Gai KUBO, Tatsuya ISHII, Yo Murata, "Performance Analysis of Acoustic Liner with Fine-Perforated-Film by Numerical Simulation Using Impulse Response Method", AIAA 2023-3636

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](%): 0.28

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	4,723,592.39	0.21
TOKI-ST	397,191.52	0.43
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	0.00	0.00
TOKI-TST	471,258.62	7.73
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	496.92	0.41
/data and /data2	12,595.38	0.08
/ssd	386.15	0.04

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[*2] (%)
J-SPACE	15.01	0.05

[*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)	107.75	0.05

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