Acoustic Liner Program for High-bypass-ratio Aricraft engines (ALPHA)

Report Number: R21EDA101P00
Subject Category: Aeronautical Technology
URL: https://www.jss.jaxa.jp/en/ar/e2021/18347/

Responsible Representative

Tatsuya Ishii, Director, Aeronautical Technology Directorate, Aviation Environmental Sustainability Innovation Hub

Contact Information

Junichi Oki(oki.junichi@jaxa.jp)

Members

Shunji Enomoto, Shono Noguchi, Junichi Oki, Daisuke Sasaki

Abstract

The trend in turbofan engines is towards higher bypass ratio and shorter nacelles. The eigne noise will increase due to smaller sound absorption area resulting from shorter nacelles. We aim to develop next-generation acoustic liner technologies that achieve both noise reduction and fuel efficiency.

Reasons and benefits of using JAXA Supercomputer System

There have been many cases with different liner geometries and incident sound frequency as analysis parameters.

Achievements of the Year

We performed numerical simulations for demonstrating aeroacoustic phenomena around an acoustic liner installed inside an aircraft engine nacelle. As shown in Fig. 1, the four different geometries of a perforated hole are adopted to investigate its effect, and 110 dB sound is incident from the upstream in a laminar flow of Mach 0.3. Fig. 2 shows the sound absorption coefficient for each of the hole geometries. We assume optimizing hole geometry would improve sound absorption performance while resonance frequency changes. In addition, our simulations extend understanding of the detailed phenomena by visualizing three-dimensional vortical structures represented in Fig. 3 and 4.

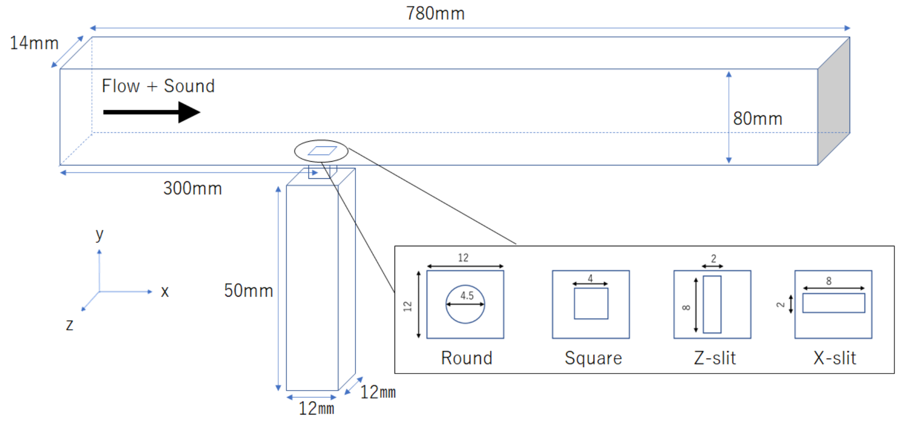


Fig. 1: Computational domain

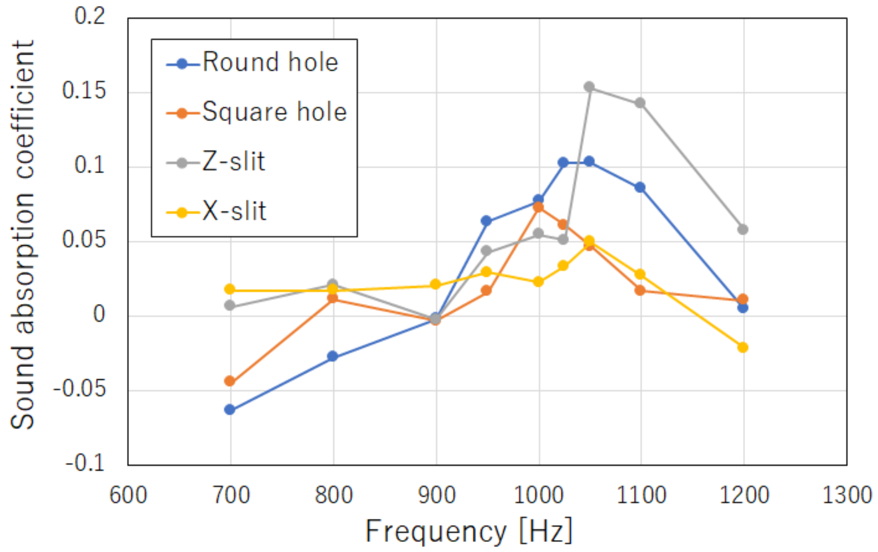


Fig. 2: Sound absorption coefficient

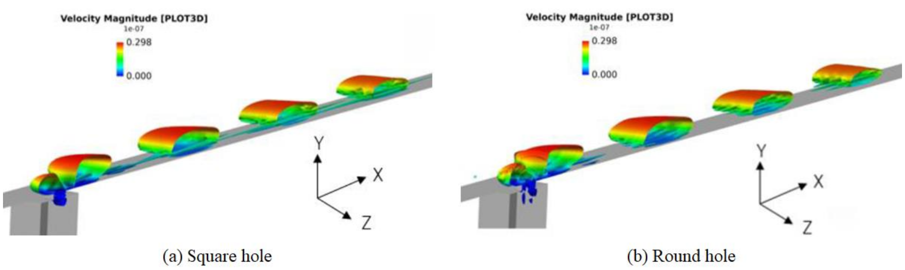
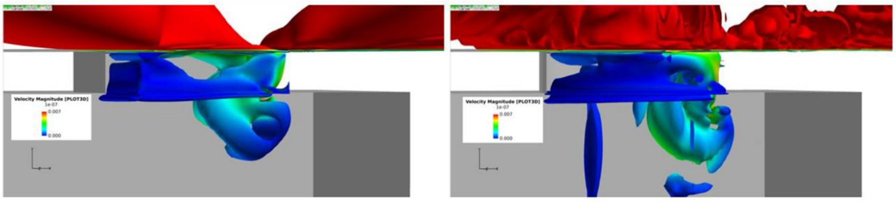


Fig. 3: Iso-surface of Q-criterion, visualizing wake vortices



(a) Square hole (b) Round hole

Fig. 4: Iso-surface of Q-criterion, visualizing vortices in the hole

Publications

- Poster Presentations

Shono Noguchi, Daisuke Sasaki, Shunji Enomoto, Junichi Oki, 3D aeroacoustics analysis for a perforated hole of the sound absorbing liner, JSME Hokuriku Shin-etsu branch, 2022.

Usage of JSS

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	OpenMP
Number of Processes	16
Elapsed Time per Case	300 Hour(s)

JSS3 Resources Used

Fraction of Usage in Total Resources[*1](%): 0.17

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	3,903,971.59	0.19
TOKI-ST	27,922.41	0.03
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	24.98	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	516.67	0.51
/data and /data2	139,605.33	1.49
/ssd	5,698.67	1.47

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2(%)
J-SPACE	23.35	0.16

*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)	274.60	0.19

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