Acoustic Liner Program for High-bypass-ratio Aircraft 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, the calculation performance and the storage capacity of JAXA supercomputer system were required.

Achievements of the Year

Acoustic liners contribute to the reduction of noise in jet engines, but they induce aerodynamic drag. The performance characteristics of acoustic liners vary depending on the shape of the orifices. In this study, we employ UPACS-LES with a compact scheme for analysis of three-dimensional turbulent flow in single acoustic liner model. Inflow Mach number is 0.3. Computations are conducted for three different orifice shapes: a Square, a Z-slit, a Round. Figure 1 shows that the flow goes into the orifices. Computational results indicate that the drag on the square orifice is higher compared to the other orifices. To investigate the reasons. The figure provides a graphical representation of the Reynolds stress distribution on the orifice surface. The figure indicates that the Reynolds stress for the square orifice is generally higher than that of the others, and it shows particularly large values near the sides. The figure illustrates the formation of vortices on both sides of the orifice. The vortices descend along the wall and rotate. This occurs only in the square orifice, thus this is the reason for the high drag.

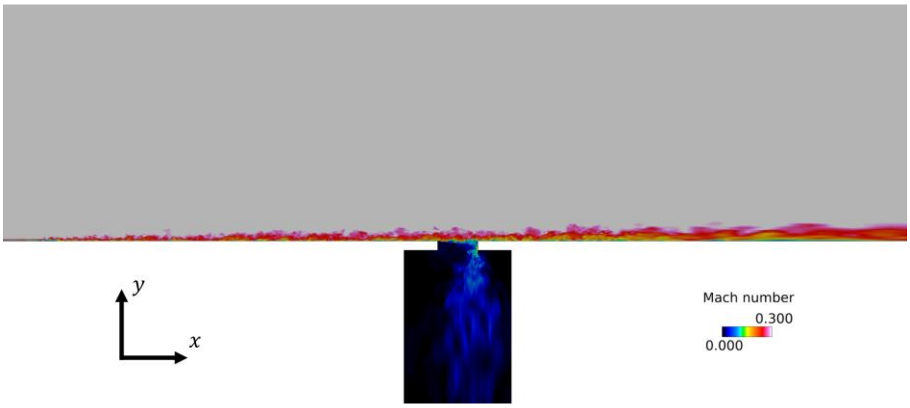

Fig. 1: Instantaneous Data of Round Orifice

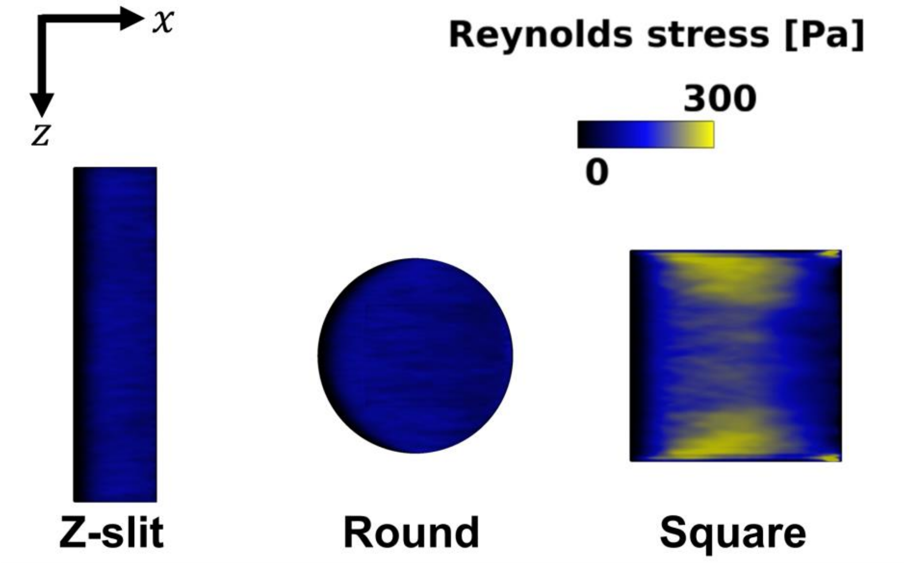

Fig. 2: Distribution of Reynolds Stress of Orifice

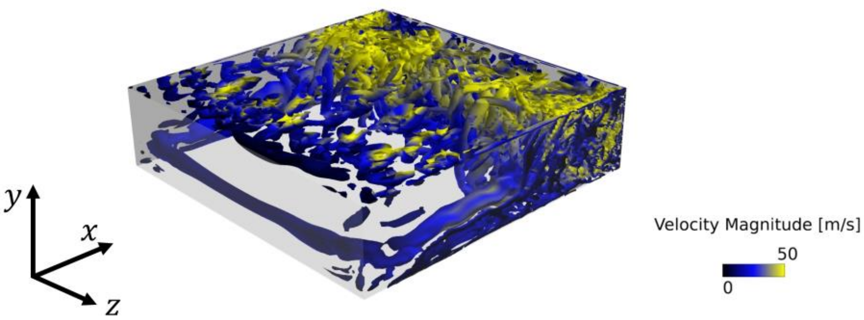

Fig. 3: Vortices of Square Orifice

Publications

- Poster Presentations

H. Matsuura, D. Sasaki, S. Enomoto, and J. Oki, Computational Estimation of Drag on an Acoustic Liner under Three-Dimensional Turbulent Flow, ICCFD12, (2024-07-14).

Usage of JSS

- **Computational Information**

Process Parallelization Methods	MPI
Thread Parallelization Methods	OpenMP
Number of Processes	128 - 140
Elapsed Time per Case	120 Hour(s)

- **JSS3 Resources Used**

Fraction of Usage in Total Resources[*1](%): 0.15

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	3,987,107.21	0.18
TOKI-ST	28,435.79	0.03
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	3,460.80	0.26
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	986.92	0.82
/data and /data2	169,375.38	1.04
/ssd	10,426.15	0.98

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)	589.43	0.27

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