Investigation of internal flow of aircraft combustor for En-Core Project.

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Abstract

In the development process of aircraft combustors, air mass flow distribution between fuel nozzles, dilution and cooling air holes on the liner effects performances of combustors. So it is important to understand the internal flow and estimate the mass flow distribution. In this research, we conduct cold-flow simulations of internal flow inside the combustor which faithfully simulates the configuration of practical combustor. Then we aim to develop methods to analyze aerodynamic performance of combustors such as air mass flow distribution with high accuracy.

Reasons and benefits of using JAXA Supercomputer System

It is important to do parametric case study with slightly different geometry, and each case needs large scale simulation. To conduct such simulation effectively, we need the super computer with high parallelization efficiency.

Achievements of the Year

This year, an analysis of non-combustion flow was conducted and compared for both a multi-sector combustor (comprising three sectors) and an annular combustor. The overall appearance and cross-sectional views of each combustor are shown in Fig.1. In combustion testing, trials and improvements were initially performed using the multi-sector combustor, followed by testing with the annular combustor. At the numerical analysis stage, predictions regarding the differences caused by variations in shape were made, along with investigations into the causes of discrepancies in test results. In calculations, the multi-sector combustor had wall boundaries on both sides of the three sectors, whereas the annular combustor had periodic boundaries on both sides of a single sector. As an example of the results, Fig.2 illustrates differences in velocity fields in the transverse section along the flow direction, revealing that as the flow proceeds downstream, the differences due to the presence or absence of wall boundaries become more pronounced.

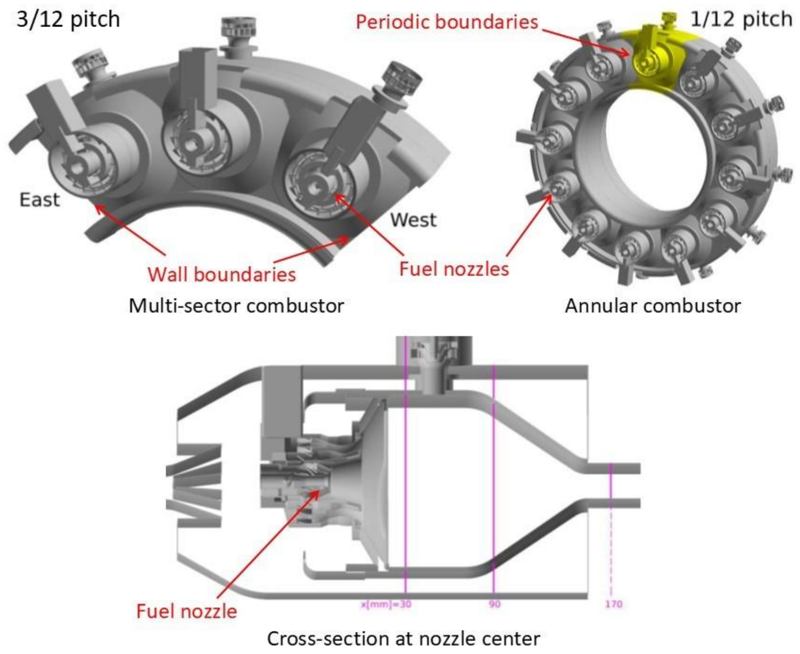

Fig. 1: Overall appearance and cross-sectional view of combustors.

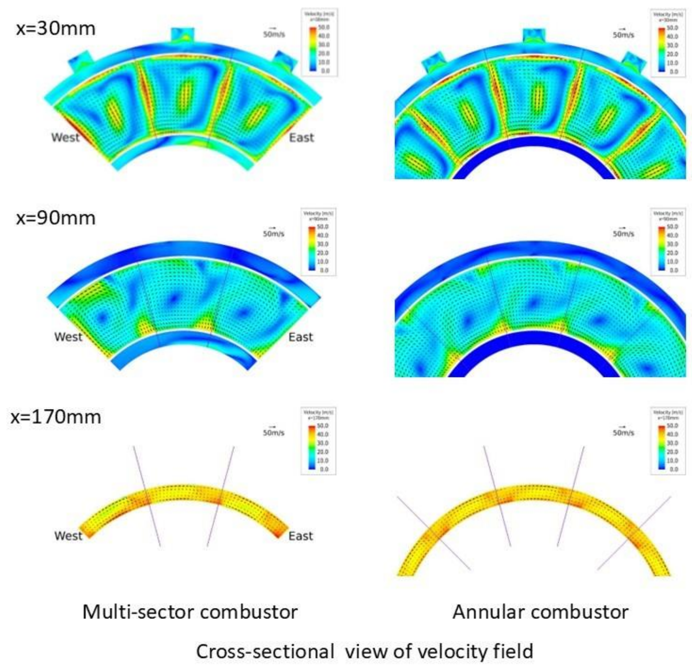

Fig. 2: Comparison of velocity fields in cross-sections.

Publications

N/A

Usage of JSS

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	Automatic Parallelization
Number of Processes	1536
Elapsed Time per Case	178 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	395,922.56	0.02
TOKI-ST	207,904.11	0.21
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	297.61	0.02
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	61.71	0.04
/data and /data2	8,320.95	0.04
/ssd	0.00	0.00

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[*2] (%)
J-SPACE	3.45	0.01

[*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)	6,066.28	4.14

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