Integrated Simulation over aircraft, rotorcraft and engines

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Abstract

In this study, with the aim of shortening the development period and reducing costs in aircraft development, we are conducting research and development on advanced Model-Based Development (MBD: Model-Based Development) and Model-Based Systems Engineering (MBSE) collaboration technologies with MBD Due to the reorganization of research cards, this fiscal year, we are conducting research and development focused on engine analysis technology under this project code.

As part of the research and development of engine analysis technology, we are conducting research on the advancement of the Cartesian grid CFD solver HINOCA-AE and the Many-block method, which is a unstructured grid method.

Reasons and benefits of using JAXA Supercomputer System

JSS is necessary to complete large scale numerical simulations of unsteady phenomena and to understand it in short time span.

Achievements of the Year

The main achievements of this fiscal year are the improvement of accuracy through the advancement of the combustion model implemented in HINOCA-AE and the enhancement of usability. The combustion model was refined based on the Flamelet method, and its accuracy was validated across multiple combustors. In several cases, it was confirmed that the exhaust temperature error could be kept within 100 K. Additionally, it was verified that grid generation from drawing data could be completed within a few days (or within a few hours for minor shape modifications), and the procedure was documented in a manual.

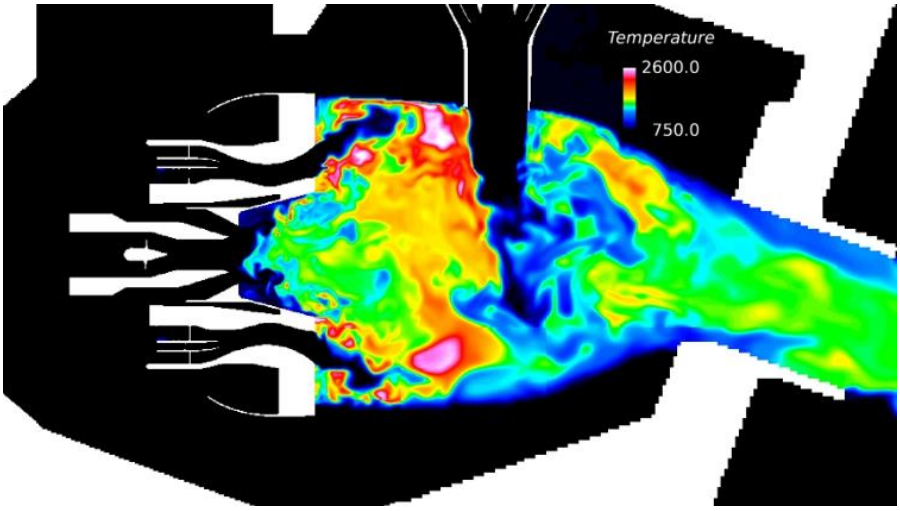

Fig. 1: An example of combustor analysis using HINOCA-AE (temperature distribution)

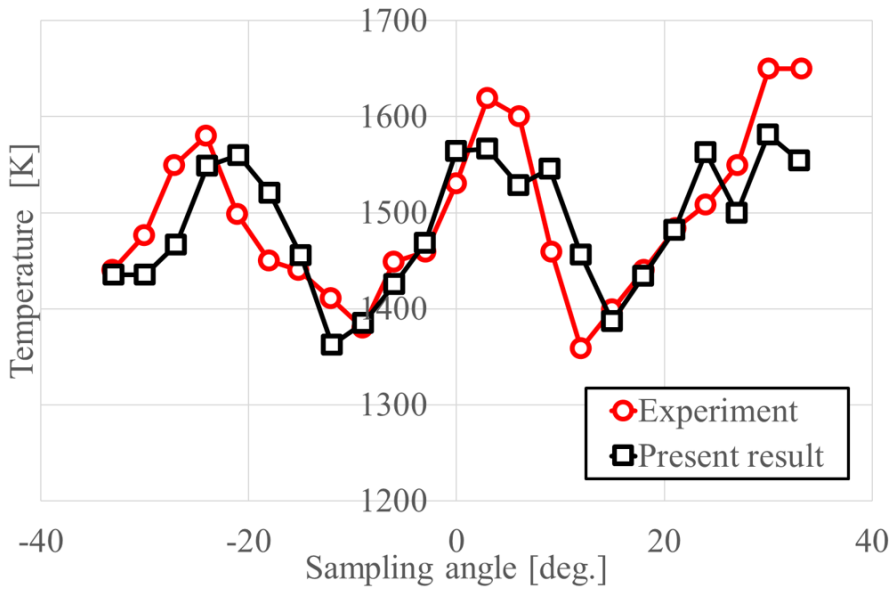

Fig. 2: An example of combustor analysis using HINOCA-AE (exhaust temperature distribution)

Publications

- Oral Presentations

Taisuke Nambu, Hiroki Yao, Takuhito Kuwabara, Ryohei Kirihara and Yasuhiro Mizobuchi, Research and Development of a Combustion Flow Analysis Program for Reciprocating Engines Using the Cartesian Grid and an Immersed Boundary Method,19th International Conference of Numerical Combustion

Usage of JSS

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	OpenMP
Number of Processes	1 - 8192
Elapsed Time per Case	480 Hour(s)

JSS3 Resources Used

Fraction of Usage in Total Resources[*1](%): 1.22

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	32,811,678.21	1.50
TOKI-ST	1,616.10	0.00
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	533.88	0.04
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	1,487.12	1.00
/data and /data2	152,594.99	0.73
/ssd	33,648.33	1.80

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2 (%)
J-SPACE	13.86	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)	3.45	0.00

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