

Application of the Cartesian grid and an IB method to the analysis of aircraft engine combustors

Report Number: R22EDA102G31

Subject Category: Aeronautical Technology

URL: <https://www.jss.jaxa.jp/en/ar/e2022/20803/>

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● Abstract

In order to reduce the cost of mesh generation and achieve practical accuracy, HINOCA-AE, a thermal and fluid dynamics solver with the Cartesian grid, is now being developed. The purpose of this research is to expand the application of numerical analysis for aero engine combustor design.

● Reasons and benefits of using JAXA Supercomputer System

Massive-parallel large scale simulation, Large number of simulations for software validation

● Achievements of the Year

In order to verify whether a solver based on the Cartesian grid and the Immersed boundary method can be used to analyze the flow with practical accuracy, a flow analysis was conducted on a test combustor under non-combustion and combustion conditions. Although there are some issues, such as improving the conservation, it was confirmed that the analysis can be performed with practical accuracy.

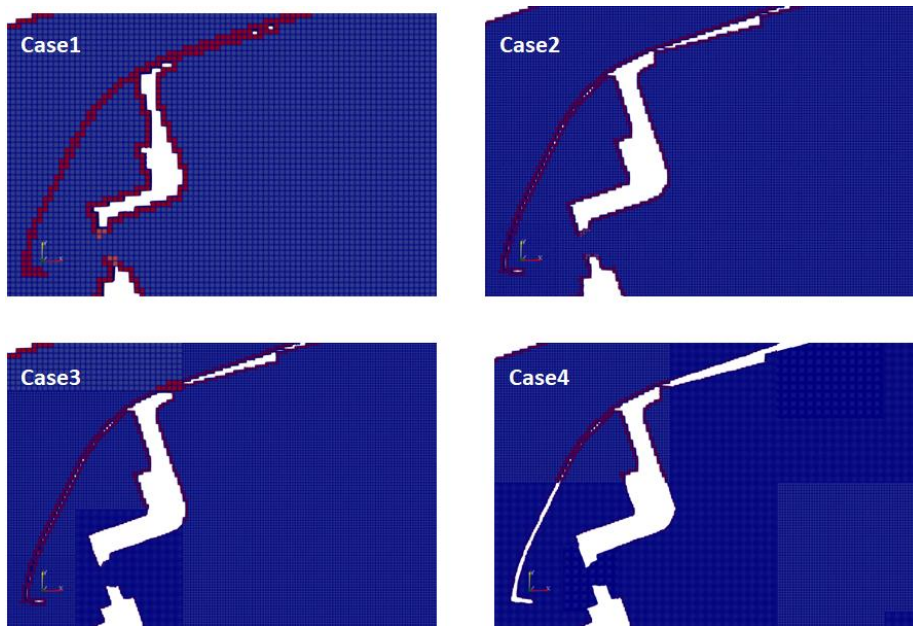


Fig. 1: Four types of computational grid with different grid densities

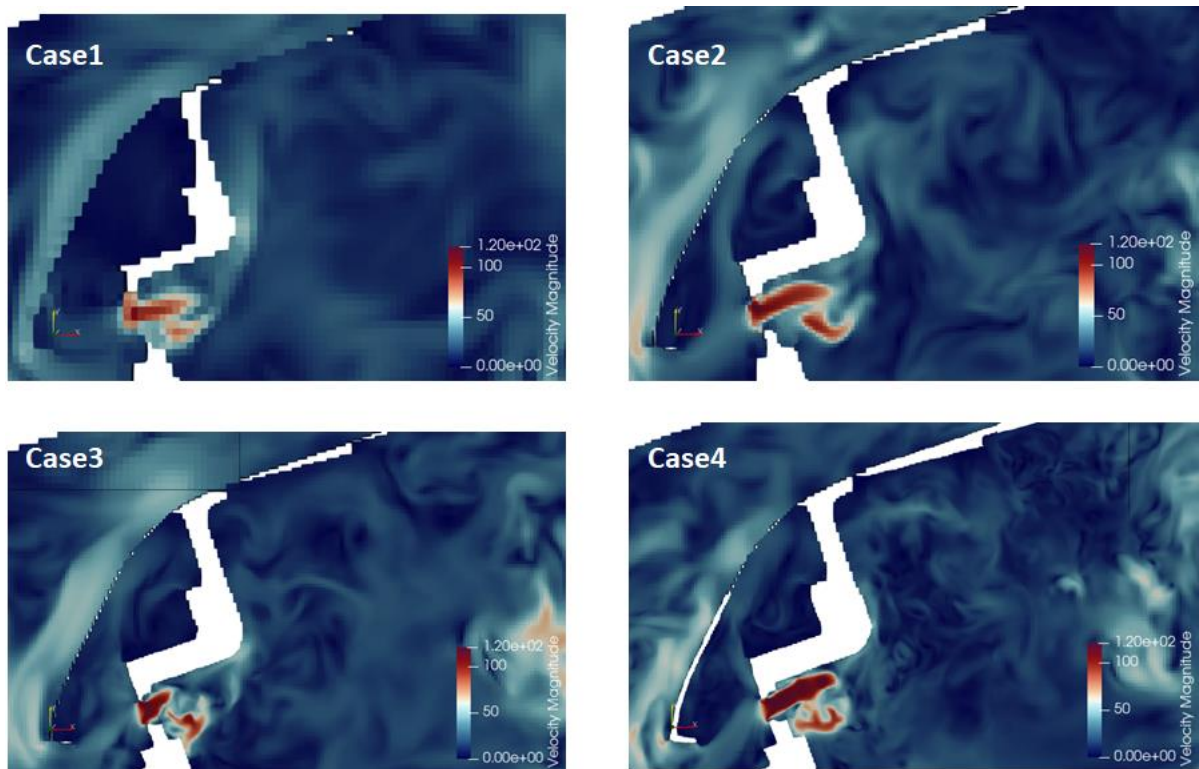


Fig. 2: Comparison of velocity distributions by computational grids with different grid densities

● Publications

- Non peer-reviewed papers

Takuya Karatsu et.al., "Cold-flow numerical simulation of an aero engine combustor with Immersed Boundary method" AJCPP2023

● Usage of JSS

● Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	OpenMP
Number of Processes	1 - 1634
Elapsed Time per Case	168 Hour(s)

● JSS3 Resources Used

Fraction of Usage in Total Resources*1(%): 0.55

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage *2(%)
TOKI-SORA	14,940,636.68	0.65
TOKI-ST	1,263.69	0.00
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	218.96	0.01
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	1,497.34	1.36
/data and /data2	124,408.13	0.96
/ssd	32,843.17	4.55

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage* ² (%)
J-SPACE	3.81	0.02

*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)	28.35	0.02

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