Improvement of numerical analysis for internal flow with complicated configuration inside aero-engine

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● **Abstract**

Unstructured-grid flow solver FaSTAR-Move-AE are applied to aero-engine analysis with complicated configuration. Through the calculation, these programs are tested and investigated for the deficiency and future issue for improvement of accuracy.

● **Reasons and benefits of using JAXA Supercomputer System**

For large scale computations in the future, programs should be tested under the same computational environment.

● **Achievements of the Year**

To validate the detailed analysis by DES/LES in FaSTAR-Move-AE, we conducted analyses of a linear cascade with cooling air holes , as well as DES/LES analysis of a centrifugal compressor including complex shapes equivalent to actual machinery. It was confirmed that analysis with reasonable accuracy is possible for the linear cascade, however, in the analysis of the centrifugal compressor, significant flow rate oscillations not observed in the experiments were occurring, becoming a future challenge for analysis.
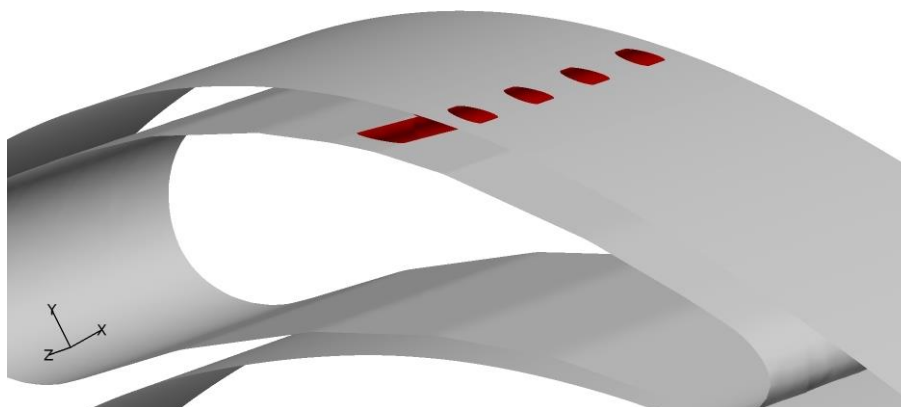
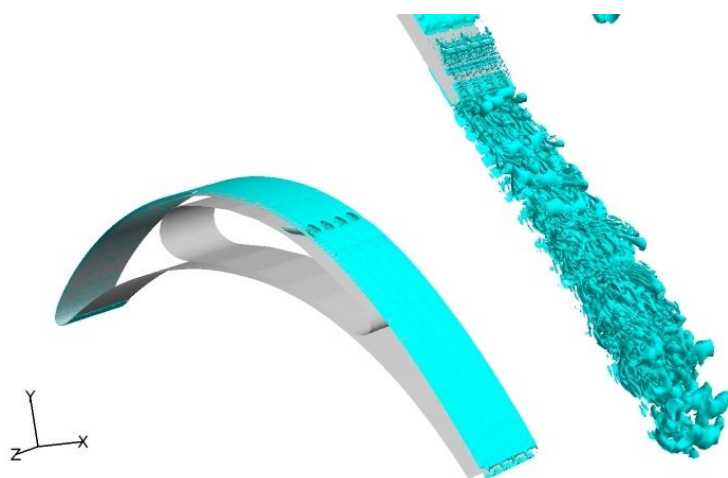Fig. 1: The analyzed turget: linear cascade with cooling holes

Fig. 2: An example of analysis results using DES/LES

● **Publications**

- Non peer-reviewed papers

Improvement of Advection Term Analysis Scheme for Aerodynamic Analysis of Blade Rows using Unstructured Grids, 2023 annual meeting of Gas turbine society of Japan

● **Usage of JSS**

● **Computational Information**

Process Parallelization Methods	MPI
Thread Parallelization Methods	N/A
Number of Processes	1 - 2048
Elapsed Time per Case	480 Hour(s)

- **JSS3 Resources Used**

Fraction of Usage in Total Resources[*1](%): 1.09

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	29,503,491.36	1.33
TOKI-ST	11,059.09	0.01
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	8,521.04	0.65
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	387.23	0.32
/data and /data2	78,975.57	0.49
/ssd	2,516.78	0.24

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[*2] (%)
J-SPACE	22.56	0.08

[*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)	329.32	0.15

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