Development of a high-precision unstructured mesh flow solver for aerodynamic design of turbomachinery cascade

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Abstract

FaSTAR-Move-AE, a fluid analysis solver for unstructured meshes, which is mainly targeted at turbomachinery analysis, is developed. This solver will enable aerodynamic analysis of cascades with complex geometry with practical accuracy and cost, and will improve the turbomachinery design of Japanese engine manufacturers.

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

We are conducting the development of the fluid analysis solver FaSTAR-Move-AE using unstructured grids, with a focus on the blade rows of turbo machinery as the main analysis target. This fiscal year, we conducted validation using publicly available data of a linear cascade with the aim of advancing detailed unsteady analysis using DES/LES.

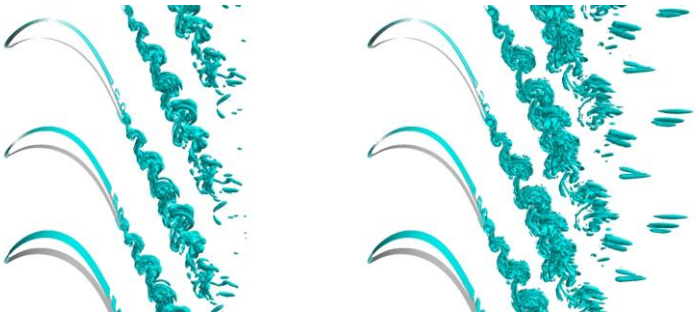

Fig. 1: Comparison of analysis results between conventional advection term analysis scheme (SLAU) and low dissipation scheme (SSKEP). (Left: SLAU method, Right: SSKEP method)

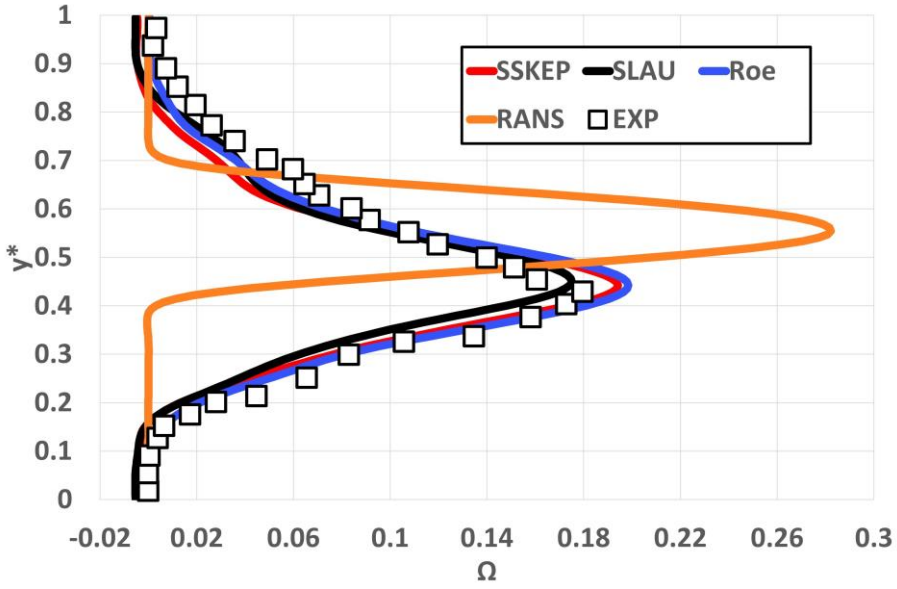

Fig. 2: Differences in downstream pressure loss analysis results due to variations in advection term analysis schemes.

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	240 Hour(s)

- **JSS3 Resources Used**

Fraction of Usage in Total Resources[*1](%): 0.10

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	2,656,834.93	0.12
TOKI-ST	809.32	0.00
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	0.00	0.00
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	192.67	0.16
/data and /data2	20,900.87	0.13
/ssd	2,130.62	0.20

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[*2] (%)
J-SPACE	7.46	0.03

[*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)	21.31	0.01

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