Development of improved numerical tools for Certification by Analysis(CbA)

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Abstract

High-accuracy simulations for stall and buffet are needed during the aircraft design. However, since the simulation cost is very high, we want to develop computation methodologies that aim at high-accuracy results with low computational cost. Hybrid RANS/LES methods (Embedded LES, ELES) have been implemented in FaSTAR and validated for different flow configurations.

Reasons and benefits of using JAXA Supercomputer System

For stall and buffet analysis, it is necessary to perform calculations on 3D complex geometries. Achieving high accuracy requires a large amount of computing power, so it is necessary to use a JAXA supercomputer.

Achievements of the Year

We applied ELES method to transonic flow over a full-aircraft geometry (named CRM) and low-speed flow over a three-element airfoil (named 30P35N) for assessing the capabilities of complex geometry simulations. The results indicate that the ELES method can conduct high-fidelity simulations for complex geometries at moderate computational cost.

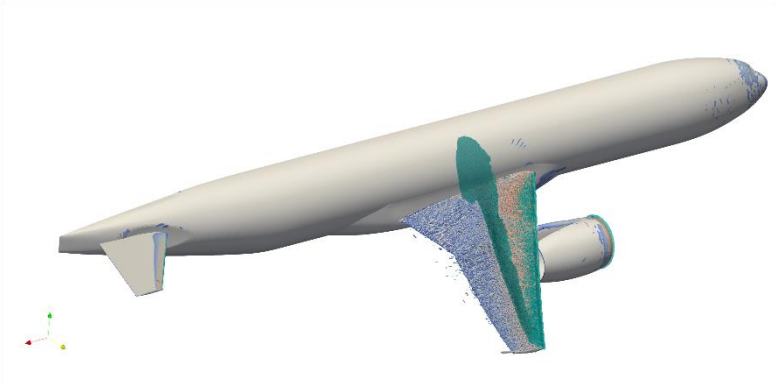

Fig. 1: Visualization of ELES result for the transonic flow over a full-aircraft

Publications

- Oral Presentations

1) Yoimi Kojima, Yoshiyasu Ichikawa, Shunsuke Koike, "Scale Resolving Simulation of Vortex Generator Flows over a Three-Elemental Airfoil Flap," AIAA Aviation Forum 2023.

Usage of JSS

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	N/A
Number of Processes	576 - 9216
Elapsed Time per Case	144 Hour(s)

- **JSS3 Resources Used**

Fraction of Usage in Total Resources[*1](%): 3.80

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	101,433,585.65	4.58
TOKI-ST	228,237.63	0.25
TOKI-GP	8,742.50	0.11
TOKI-XM	5,914.04	3.24
TOKI-LM	43,782.22	3.34
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	1,553.74	1.29
/data and /data2	172,187.67	1.06
/ssd	35,010.60	3.31

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[*2] (%)
J-SPACE	32.17	0.12

[*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)	2,077.79	0.94

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