Laminar-turbulent transition simulation in aFJR High efficiency fan technology development

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Abstract

One of the goals of the aFJR project is to reduce the fuel consumption of aero-engines. In the aFJR project, we have attempted to estimate the transitions in the boundary layer of the fan blade surface using LES analysis. This year, in order to reduce the computational load, a trial calculation of a method to reduce the computational domain by using sponge boundaries was performed.

Reasons and benefits of using JAXA Supercomputer System

The numerical simulation for predicting the turbulent flow transition is difficult to execute without a supercomputer due to the large amount of calculation.

Achievements of the Year

The target of the calculation is the shape of a single blade installed in a wind tunnel. Until last year, we used a grid that simulated the entire wind tunnel as shown in Fig. 1. Fig. 2 shows the location of the sponge boundary and the distribution of the flow field. The gray grid shows the actual calculation area. Fig. 3 shows the results of the calculation under these conditions. The sponge boundary and the computational domain are almost perfectly connected, which shows that the calculation can be done in this way.

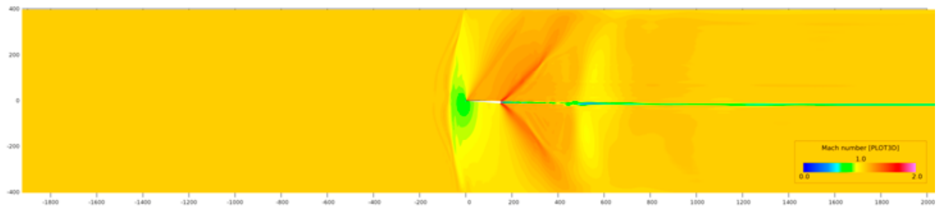

Fig. 1: conventional computing domain

Fig. 2: Sponge boundary and flow distribution

Fig. 3: the result of sponge boundary method

Publications

N/A

Usage of JSS

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	OpenMP
Number of Processes	36
Elapsed Time per Case	120 Hour(s)

- **Resources Used(JSS2)**

Fraction of Usage in Total Resources*1(%): 0.08

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage*2(%)
SORA-MA	0.00	0.00
SORA-PP	66,428.16	0.52
SORA-LM	0.00	0.00
SORA-TPP	26,269.70	2.48

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage*2(%)
/home	9.72	0.01
/data	3,192.61	0.06
/ltmp	638.52	0.05

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2(%)
J-SPACE	11.02	0.36

*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.

- **Resources Used(JSS3)**

Fraction of Usage in Total Resources*1(%): 0.00

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage*2(%)
TOKI-SORA	0.00	0.00
TOKI-RURI	0.00	0.00
TOKI-TRURI	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage*2(%)
/home	12.98	0.01
/data	5,696.62	0.10
/ssd	566.38	0.30

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2(%)
J-SPACE	11.02	0.36

*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.