Study on numerical analysis of unsteady compressible flow field

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Abstract

Stability analysis is a method to investigate the time-evolution of disturbance field applied to the flow field. In this study, we develop a numerical method suitable for the analysis of compressible flow considering the accurate track of nonlinear time-evolution of the disturbance field. To understand the effect of compressibility on the time-evolution of disturbance field, we apply the developed method to the flow around an airfoil and over a flat plate to investigate the physical property of unsteady compressible flow.

Reasons and benefits of using JAXA Supercomputer System

For the stability analysis considering the time-evolution of disturbance field, sufficient temporal and spatial resolution are needed, indicating that the analysis with JSS3 is needed.

Achievements of the Year

In this year, we conducted the nonlinear stability analysis on (a) supersonic channel flow and (b) subsonic flow around an airfoil, and we obtained the following results.

(a) In supersonic boundary layer, the existence of inviscid instability is well known in addition to incompressible instability of Tollmien-Schlichting waves. We focused on the time-eveolution of these invisvid instabilities in finite time, and we investigated the type of initial disturbance field to evolve within the evaluation time.

(b) In high subsonic flow around an airfoil, the flow involves the low-frequency oscillations in a case of low angle-of-attack. This kind of oscillation may cause a damage to the flight and the reduction is important theme in engineering. In this study, we formulated the nonlinear stability analysis for these strongly unsteady flow field, and we conducted the demonstaration by using the numerical analysis.

Publications

N/A

Usage of JSS

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	OpenACC
Number of Processes	1 - 3
Elapsed Time per Case	24 Hour(s)

JSS3 Resources Used

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

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	0.00	0.00
TOKI-ST	0.00	0.00
TOKI-GP	1,414.68	0.02
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	90.00	0.06
/data and /data2	29,900.00	0.14
/ssd	0.00	0.00

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2 (%)
J-SPACE	0.00	0.00

*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)	0.00	0.00

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