Cooperative Research: Research on Dynamic Stabiilty Analysis

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Responsible Representative

Takashi Aoyama, Aeronautical Technology Directorate, Numerical Simulation Research Unit

Contact Information

Yoimi Kojima(kojima.yoimi@jaxa.jp)

Members

Atsushi Hashimoto, Takashi Ishida, Keiji Ueshima, Minoru Yoshimoto, Ichiro Maeda, Yoshihiro Tachibana, Takashi Aoyama, Kanako Yasue, Hitoshi Arizono, Yoimi Kojima

Abstract

The aircraft dynamic stability is an essential information for evaluating the flight stability and designing the aircraft maneuver control systems. But there are limitations for the textbook-based estimations and the wind tunnel tests and, therefore, the CFD-based stability analysis is expected to dissolve the limitations. Our objective in this research is to apply FaSTAR, a high-speed solver for compressible flow developed in JAXA, for predicting the dynamic derivatives to validate the accuracy of the code.

Reasons and benefits of using JAXA Supercomputer System

The prediction for the dynamic derivatives requires quite a bit of numerical simulations, both for steady and unsteady states. The vast computational resources provided by JSS allow us to enhance the process and make it much faster than we do them on desktop computers.

Achievements of the Year

We conducted steady and unsteady numerical simulations over a Standard Dynamics Model (SDM) for predicting the dynamic derivatives. We employed RANS (Reynolds-Averaged Navier-Stokes equation) method for simulating the turbulent flows over the model; the Spalart-Allmaras model is adopted for the closure. The pressure field visualization around the SDM (figure 1) indicates that the simulations are conducted properly. We also compared the derivatives with experimental results (figure 2) and confirmed that the simulation could provide accurate predictions for aircraft's dynamic stability.

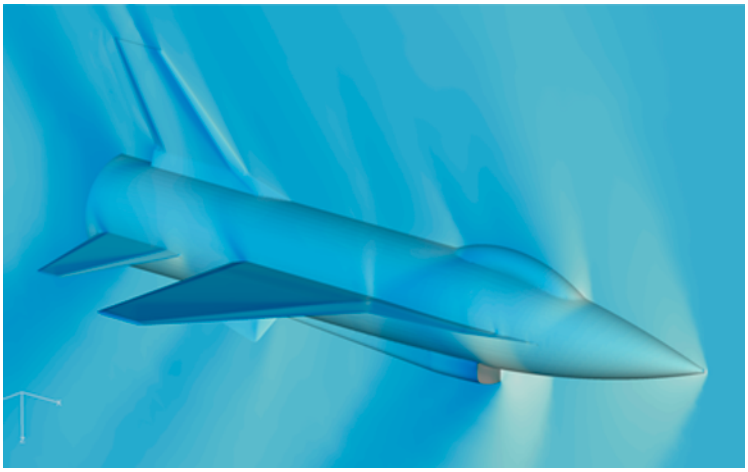

Fig. 1: Pressure distribution around the SDM model (AoA=5 deg., M=1.2)

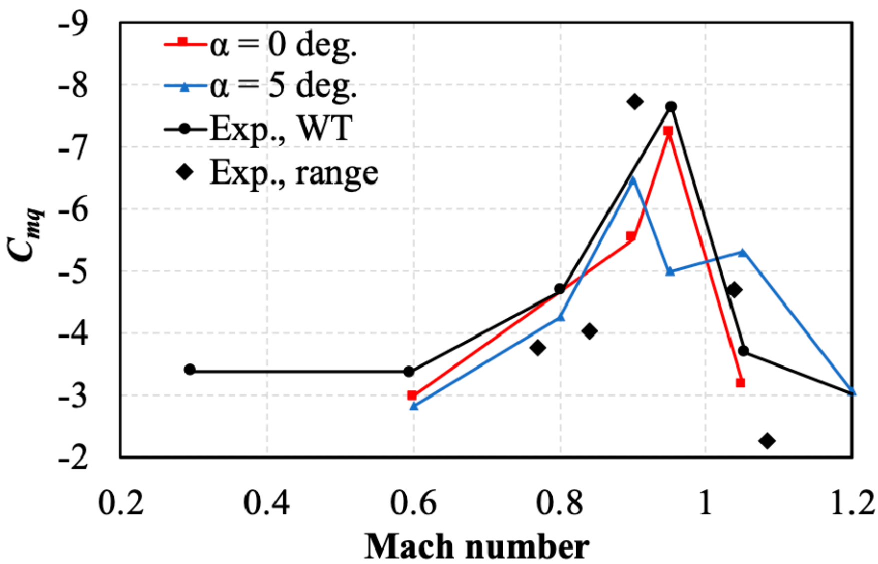

Fig. 2: Dynamic stability derivatives for the SDM model over the Mach number

Publications

N/A

Usage of JSS

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	N/A
Number of Processes	64 - 128
Elapsed Time per Case	144 Hour(s)

- **Resources Used(JSS2)**

Fraction of Usage in Total Resources[*1](%): 0.04

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage[*2](%)
SORA-MA	67,914.67	0.01
SORA-PP	233.09	0.00
SORA-LM	1,260.59	0.74
SORA-TPP	7,770.90	0.73

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage[*2](%)
/home	229.11	0.21
/data	26,650.34	0.51
/ltmp	3,898.22	0.33

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[*2](%)
J-SPACE	39.54	1.31

[*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](%): 0.13

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	556,500.77	0.12
TOKI-RURI	692.35	0.00
TOKI-TRURI	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage[*2](%)
/home	497.19	0.34
/data	37,902.66	0.64
/ssd	1,161.36	0.61

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[*2](%)
J-SPACE	39.54	1.31

[*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.