Research of numerical prediction for the flight stability

● **Responsible Representative**

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● **Abstract**

The flight stability of aircraft is necessary to establish safe flight. We aim to improve the technology level of flight stability prediction through numerical simulation. The numerical method is validated and analyzed for developing better numerical tools.

● **Reasons and benefits of using JAXA Supercomputer System**

Unsteady simulations required for the stability analysis demand large computational resources and produce much data. JSS allows us to simulate and analysis of numerical results.

● **Achievements of the Year**

We conducted several unsteady numerical simulations with forced roll oscillation to analyze roll instability of a high-mobility aircraft. The Spalart-Allmaras model based delayed detached eddy simulation (DDES) method is used as a turbulence model. The visualization of unsteady flow over the main wing indicates that the interaction between the shock wave and separation is the source of the roll instability.
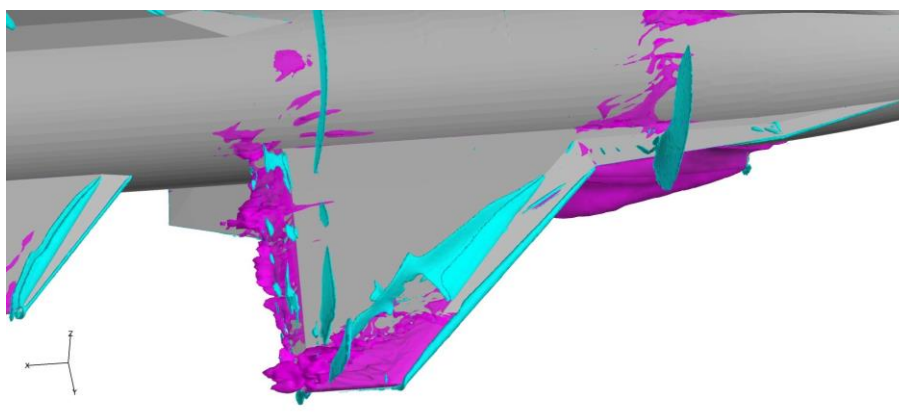
Fig. 1: Shock (blue) and separation (red) interaction over the main wing (Video.
Video is available on the web.)

● **Publications**

- Oral Presentations

1) Yoimi Kojima, Akiko Hidaka, Shinji Nagai, "Numerical Analysis of Roll Instability Phenomenon in Transonic Flow over a SDM," 56th FDC/42nd ANSS, 2023. (In Japanese)

2) Yoimi Kojima, Akiko Hidaka, Shinji Nagai, "Numerical Analysis of Uncommanded Lateral-Directional Motions of SDM in Transonic Flow," AIAA SciTech Forum 2024, 2024.

● **Usage of JSS**

● **Computational Information**

Process Parallelization Methods	MPI
Thread Parallelization Methods	N/A
Number of Processes	1152 - 3456
Elapsed Time per Case	300 Hour(s)

● **JSS3 Resources Used**

Fraction of Usage in Total Resources[*1](%): 1.56

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	42,317,253.84	1.91
TOKI-ST	8,845.67	0.01
TOKI-GP	0.00	0.00
TOKI-XM	80.08	0.04
TOKI-LM	246.63	0.02
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	37.73	0.03
/data and /data2	34,326.12	0.21
/ssd	386.15	0.04

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[*2] (%)
J-SPACE	26.78	0.10

[*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)	25.59	0.01

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