Research of numerical prediction for the flight stability

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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

To enable rapid prediction of roll instability, a prediction technique based on Global Stability Analysis (GSA) was developed. Using FaSTAR-GSA, a fast analysis tool, flow instabilities were predicted. Analysis of the eigenvalue distribution obtained from GSA (Fig. 1) revealed that under flow conditions where roll instability occurs in experiments, unstable eigenvalues corresponding to the flow field were identified. GSA successfully predicted the flow conditions under which roll instability arises. Furthermore, visualization of the unstable mode (Fig. 2) showed that the flow instability originates near the wingtip of the main wing.
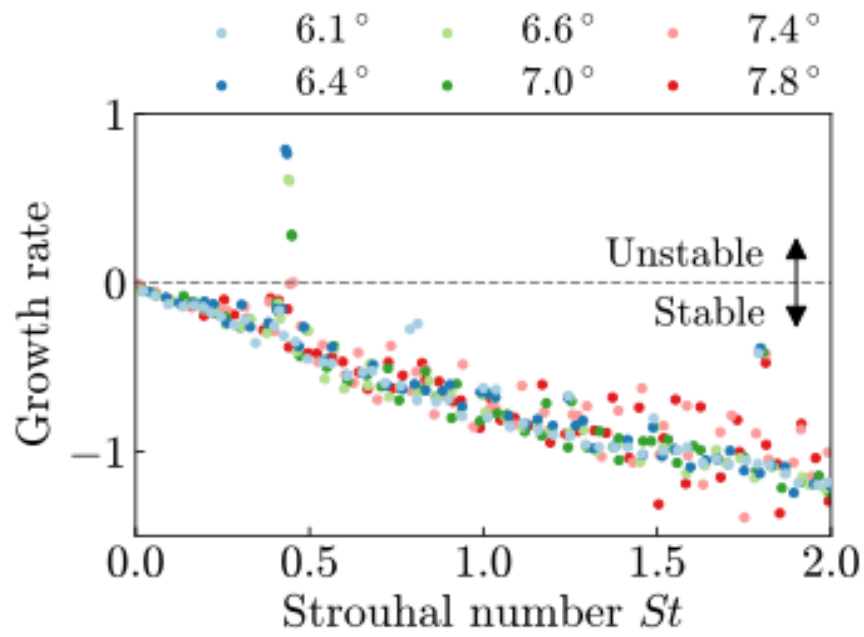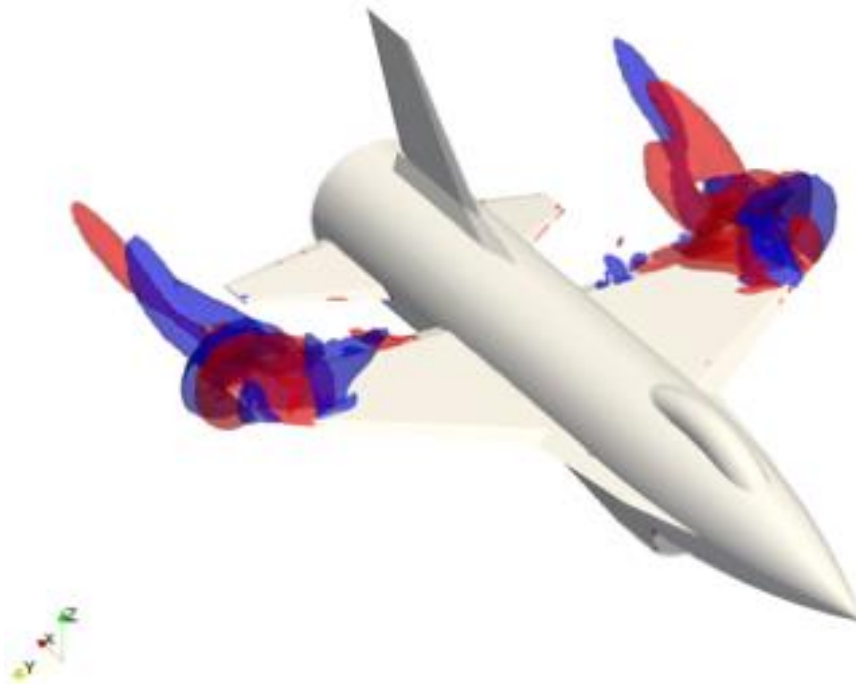
Fig. 1: Eigenvalue distributions by GSA

Fig. 2: Unstable velocity mode

● **Publications**

- Oral Presentations

Kojima, Hidaka, Nagai, On the transonic roll instability of SDM model, 56th FDC/42nd ANSS, 2D04, 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](%): 0.98

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[2](%)
TOKI-SORA	26,315,953.43	1.20
TOKI-ST	29,597.34	0.03
TOKI-GP	0.00	0.00
TOKI-XM	10.08	0.00
TOKI-LM	10,174.22	0.73
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	33.38	0.02
/data and /data2	48,157.17	0.23
/ssd	239.05	0.01

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[2] (%)
J-SPACE	17.59	0.06

[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)	457.15	0.31

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