Study on dynamic instability of a reentry capsule at transonic speed

Report Number: R21ETET12
Subject Category: Skills Acquisition System
URL: https://www.jss.jaxa.jp/en/ar/e2021/18139/

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Abstract

Atmospheric entry capsules are known to be prone to dynamic instabilities during subsonic to transonic speed flight.It has also been suggested that low-frequency fluid phenomena may have an effect on the dynamic instability. In this study, in order to better understand wake phenomena, numerical fluid simulations were performed on a normal flat plate to investigate the wake structure using dynamic mode decomposition.

Reasons and benefits of using JAXA Supercomputer System

Large computation cost to simulate unsteady flow fields.

Achievements of the Year

A DMD analysis was performed on the numerical results for a normal flat plate at M=0.2. Figure 1 shows the collapse of the spanwisel vortex at low frequencies obtained from the DMD. The wavelength of the collapse is shown in Figure 2, and the characteristic structure of the low-frequency fluid phenomenon can be found.

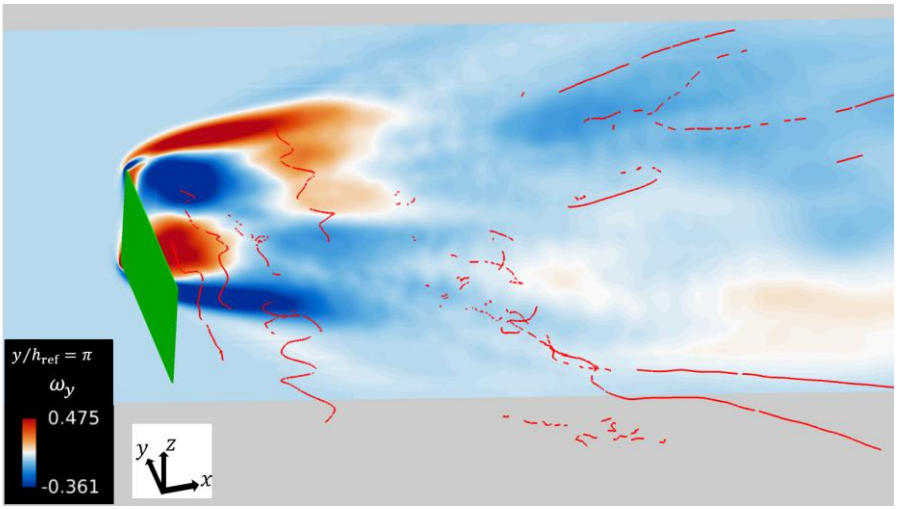

Fig. 1: Vortex core structure behind a normal flat plate

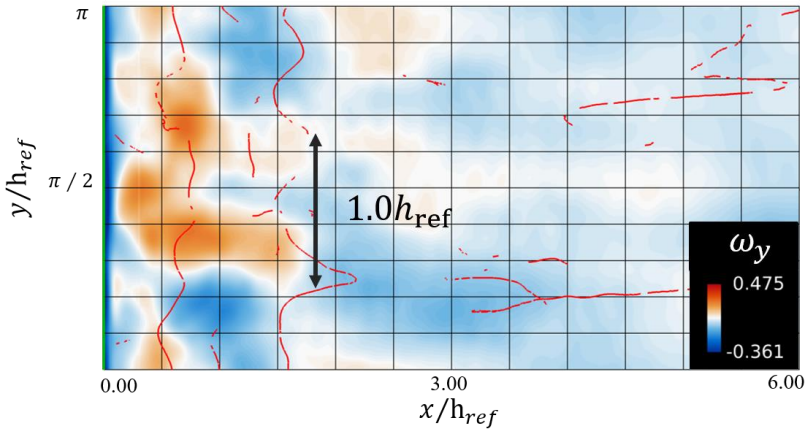

Fig. 2: Decay wavelength of vortex core

Publications

- Oral Presentations

M. Harafuji, Y. Ohmichi, M. Kanazaki, "Mode Decomposition Analysis for Low-Frequency Phenomenon of the Wake behind a Normal Flat Plate"AIAA SCITECH 2022 Forum, January 2022.

Usage of JSS

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	N/A
Number of Processes	128 - 524
Elapsed Time per Case	50 Hour(s)

- **JSS3 Resources Used**

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

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	769,164.12	0.04
TOKI-ST	43,897.03	0.05
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	11,639.31	0.87
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	250.00	0.25
/data and /data2	44,544.00	0.48
/ssd	50.00	0.01

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[*2](%)
J-SPACE	28.77	0.19

[*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)	365.00	0.26

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