

Research and Development of Sample Return Capsule for future planetary exploration

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● Abstract

Hayabusa' is the first sample return mission to an asteroid in deep space and proved its significance worldwide. The sample return mission will become one of the important missions in future planetary exploration. A sample return capsule is indispensable technology to realize it. The objectives of this activity are to take over its heritage and to enhance its technology in order to realize the flexible and attractive future sample return mission.

● Reasons for using of JSS2

Computational fluid dynamics related the sample return capsule was carried out using super computer. These results will be reflected in the design of future sample return capsules. It is generally difficult to reproduce the fluid dynamic condition in free flight of sample return capsule in ground tests. The numerical simulation is useful to understand the fluid dynamics phenomenon. However, the numerical simulation related to fluid dynamics requires the large computational resource. So, the super computer is indispensable. Its complex fluid dynamics around the sample return capsule can be understood, combining the results of both ground tests and numerical analyses using a super computer.

● Achievements of the Year

In this year, the numerical fluid analysis was carried out, focused on the wake flow field of Hayabusa-type sample return capsule using the numerical code with Baldwin-Lomax turbulence model (Fig.1). A wake flow field is important information for the design of the parachute deployment method and for the evaluation of the aerodynamic instability. In this study, the effect of the flow conditions including an angle of attack and a uniform velocity on the wake flow field was investigated (Fig.2). Additionally, these numerical results were compared with experimental results, that is visualized wake flow in low

speed wind tunnel by PIV method in order to confirm the validity of the adopted numerical analysis method (Fig.3). In the future, this numerical code and method will be utilized for the development of the aerodynamics database to the future sample return capsule design and for the evaluation of aerodynamic performance.

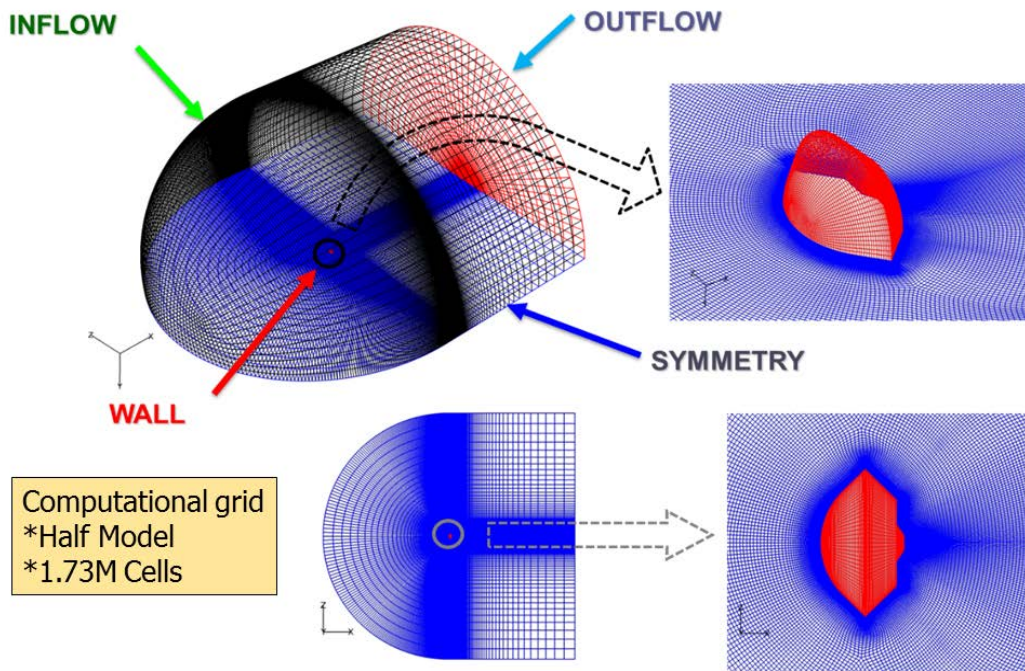


Fig.1 Computational grid

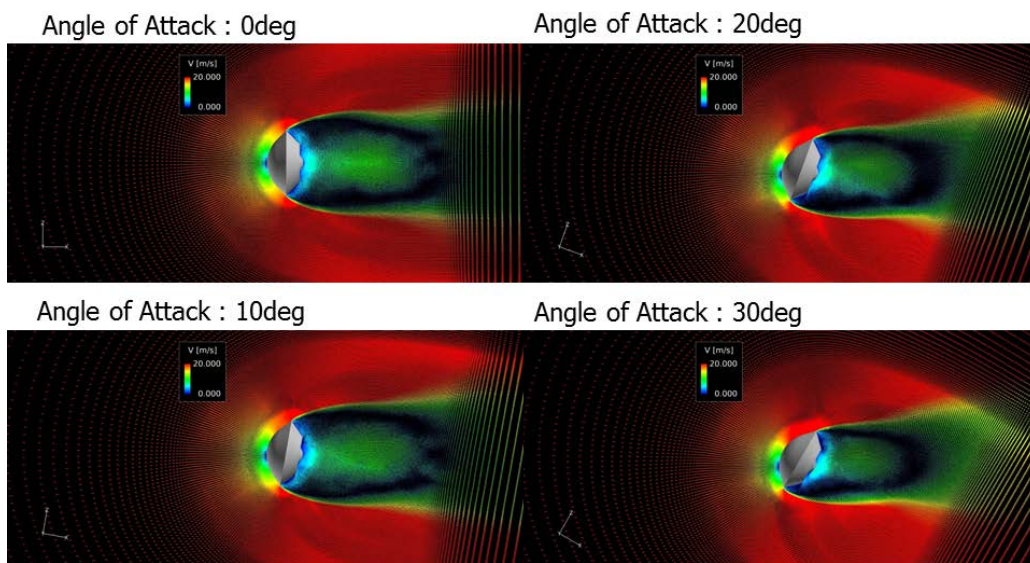


Fig.2 Flow field around the Hayabusa-type sample return capsule in the case of various angle of attacks.

Velocity profile in wake flow along the body axis.

Comparison between CFD results and PIV visualization in low speed wind tunnel test.

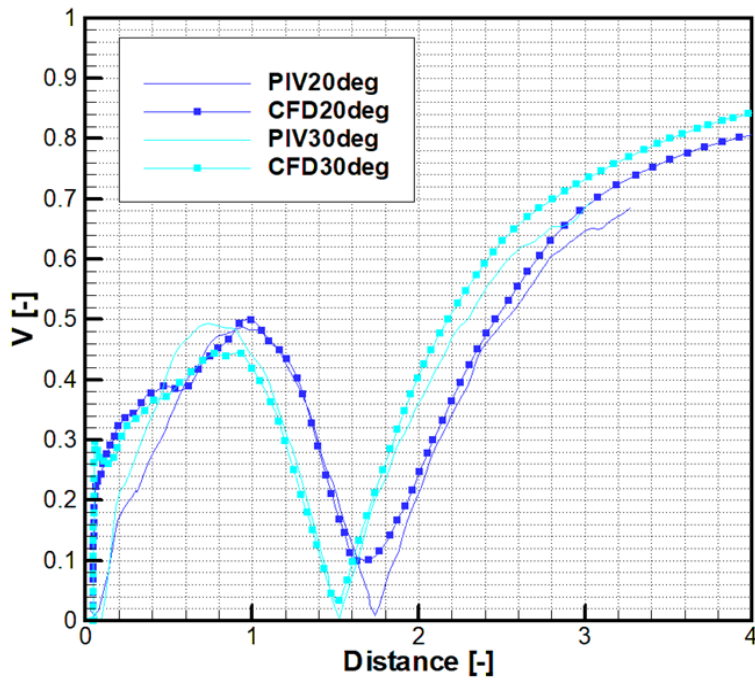


Fig.3 Comparison between CFD results and wind tunnel results about velocity profile in wake flow

● Publications

● Presentations

- 1) Kazuki Nohara, "Numerical simulation and flow visualization of wake flow field of Hayabusa-Type sample return capsule", Symposium on Flight Mechanics and Astrodynamics: 2017, sagamihara.

● Usage of JSS2

● Computational Information

Parallelization Methods	MPI
Thread Parallelization Methods	N/A
Number of Processes	64
Elapsed Time per Case	104.00 hours

● Resources Used

Fraction of Usage in Total Resources*1 (%): 0.01

Details

Computing Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage*2 (%)
SORA-MA	80,382.74	0.01
SORA-PP	15.28	0.00
SORA-LM	0.00	0.00
SORA-TPP	0.00	0.00

File System Resources		
File System Name	Storage assigned(GiB)	Fraction of Usage*2 (%)
/home	028.61	0.02
/data	286.10	0.01
/ltmp	5,859.38	0.44

Archiver Resources		
Archiver System 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