

## Aerodynamics of Re-entry Capsule with Hyperbolic Contours

Report Number: R23EACA56

Subject Category: JSS Inter-University Research

URL: <https://www.jss.jaxa.jp/en/ar/e2023/23760/>

### ● Responsible Representative

Hiroataka Otsu, Professor, Ryukoku University

### ● Contact Information

Hiroataka Otsu, Professor, Ryukoku University(otsu@rins.ryukoku.ac.jp)

### ● Members

Hiroataka Otsu

### ● Abstract

For development of future sample return capsule, we applied the hyperbolic contours to design the front shape of the capsule. To find the optimal shape of the capsule, we performed CFD analyses.

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

There have been many shapes depending on the parameter for hyperbolic curves with various flight conditions such as Mach number and AoA.

### ● Achievements of the Year

In this fiscal year, aerodynamic characteristics of a hyperbolic re-entry capsule in the transonic region were investigated by wind tunnel experiments and numerical fluid dynamics analysis. The JSS version of FaSTAR was used for the analysis, and HexaGrid v1.2.1 was used for grid generation. In the transonic region, the shock wave formed in front of the capsule becomes bow-shaped and is strongly reflected in the flow path in the wind tunnel. In order to reproduce this phenomenon, a dense computational grid was created over almost the entire computational domain, and an analysis was performed taking into account reflections at the walls. As a result, it was possible to qualitatively reproduce the shock wave formed in the front and the shock wave reflected in the flow path in the wind tunnel.

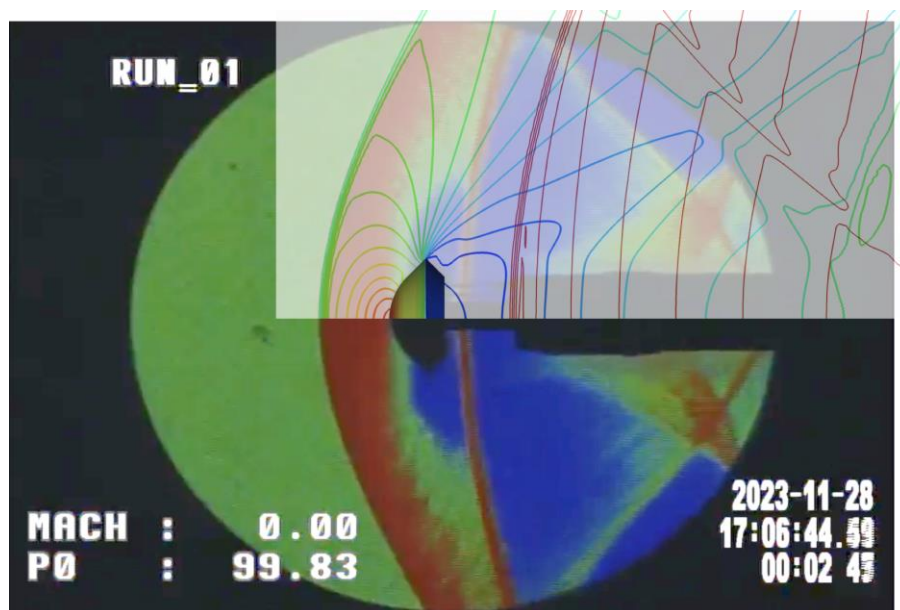


Fig. 1: Comparison of shock wave shapes around the capsule in the transonic region

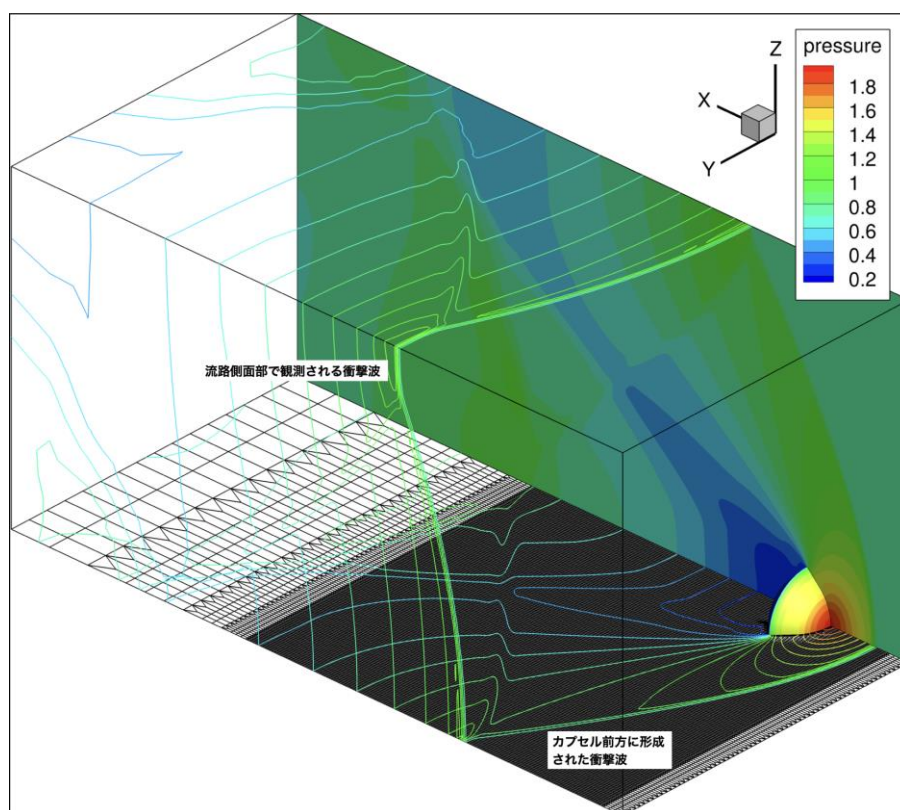


Fig. 2: CFD Reproduction of Shock Wave Shapes around a Capsule in a Transonic Wind Tunnel Experiment

## ● Publications

- Oral Presentations

"Fabrication of experimental wind tunnel model using 3D printer and its application to transonic wind tunnel experiments," ISAS2023-SFMA-023

## ● Usage of JSS

### ● Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	N/A
Number of Processes	64 - 192
Elapsed Time per Case	60 Minute(s)

### ● JSS3 Resources Used

Fraction of Usage in Total Resources\*1(%): 0.00

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage*2(%)
TOKI-SORA	345.44	0.00
TOKI-ST	40.35	0.00
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	0.00	0.00
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* <sup>2</sup> (%)
/home	0.00	0.00
/data and /data2	0.00	0.00
/ssd	0.00	0.00

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage* <sup>2</sup> (%)
J-SPACE	0.00	0.00

\*<sup>1</sup>: Fraction of Usage in Total Resources: Weighted average of three resource types (Computing, File System, and Archiver).

\*<sup>2</sup>: 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* <sup>2</sup> (%)
ISV Software Licenses (Total)	0.00	0.00

\*<sup>2</sup>: Fraction of Usage : Percentage of usage relative to each resource used in one year.