Numerical analysis of test resutls obtained in high-enthalpy shock tunnel HIEST

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Abstract

Analysis on high-enthalpy flow

Reasons and benefits of using JAXA Supercomputer System

High speed calculation　and good convenience

Achievements of the Year

During the second stage re-entry of expendable launch vehicles, most spacecraft components will be demise, but some may survive the harsh, high-temperature environment and impact the surface. Since the safety of this surviving debris's dispersal region must be guaranteed, the launch window may be restrained. If the prediction accuracy of the dispersal area can be improved, it will be possible to reduce the restricted area and improve the flexibility of launch conditions.

JAXA has been continuing research activities on developing analysis codes to improve the prediction accuracy of the dispersal area. In the current study, free-piston shock tunnel tests were conducted to assess the aero heating on a rocket engine nozzle as a typical component that is likely to remain as debris. A simplified scaled model of the 2nd-stage rocket engine nozzle was used, which model has thirty-two miniature thermocouples instrumented on the outer and inner surface of the nozzle. The surface heat flux distribution of the outside-wall and inside-wall of the nozzle were obtained under high-enthalpy real-gas conditions. High-speed schlieren video images were also recorded to observe flow around the nozzle. The measurements were compared with a JAXA in-house numerical code and agreed moderately. Unsteady fluctuation of shock waves at the nozzle exit was also observed, which fluctuation caused surface heat-flux oscillation.

Publications

N/A

Usage of JSS

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	OpenMP
Number of Processes	1 - 2
Elapsed Time per Case	10 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	2.56	0.00
TOKI-ST	0.00	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[*2](%)
/home	3.33	0.00
/data and /data2	0.00	0.00
/ssd	33.33	0.01

Archiver Resources		
Archiver 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.

- **ISV Software Licenses Used**

ISV Software Licenses Resources		
	ISV Software Licenses Used (Hours)	Fraction of Usage*2(%)
ISV Software Licenses (Total)	0.00	0.00

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