Study on spacecraft dynamics

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Abstract

Specifically, we performed (1) a performance analysis of the air intake of an air-breathing engine installed on a space transport aircraft, (2) an evaluation of the interference between the thruster jet and the surface of a celestial body when a lander lands on the celestial body, and (3) an analysis of the flow characteristics of an electric pump for supplying propellant to a spacecraft.

Reasons and benefits of using JAXA Supercomputer System

Each of these themes is being carried out in a complementary manner with experiments, and by using JSS3, analyses can be performed extremely quickly, making it possible to carry out numerical analysis that is effective in setting experimental conditions and understanding experimental results.

Achievements of the Year

(1) We evaluated the flow characteristics of the air intake of an air-breathing engine mounted on a vertical take-off and landing rocket just before landing. Figure 1 shows the Mach number contours of the flow field in a typical configuration.

(2) We evaluated the interference between the thruster jet and the surface of a celestial body when a lander lands on the celestial body. Figure 2 shows the analysis results (Mach number contour) of the thruster jet flow assuming the shape of the celestial body.

(3) We performed a flow field analysis of a cascade pump, which is focused on as an electric pump for supplying propellant to spacecraft. Figure 3 shows an example of the flow field analysis results.

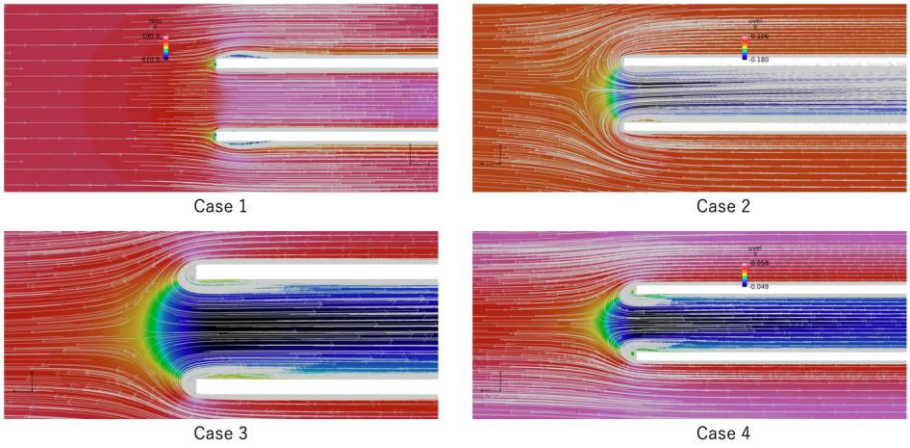

Fig. 1: Example of flow field analysis result of backflow suction

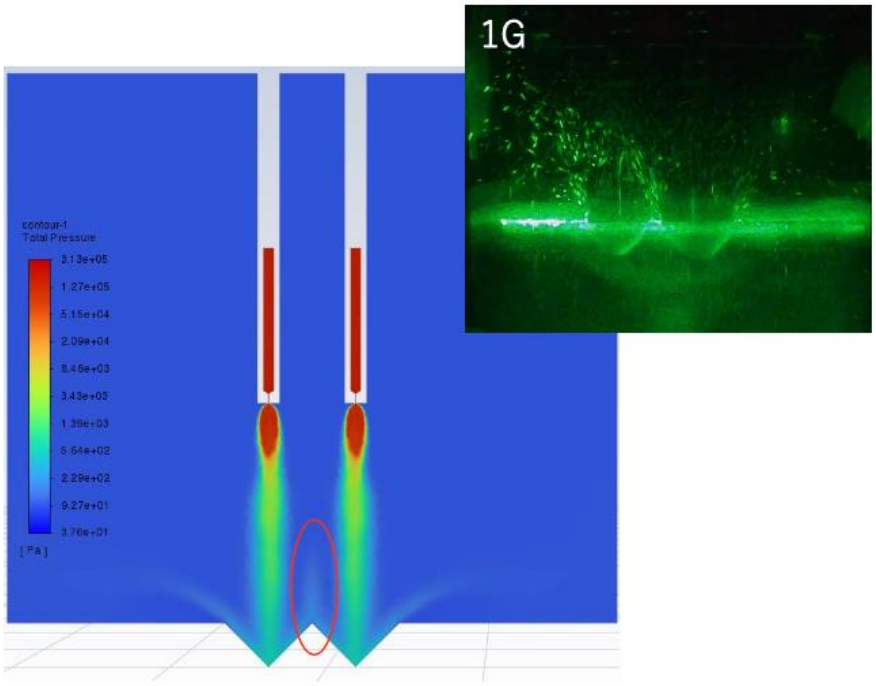

Fig. 2: Thruster jet flow analysis and experimental observations

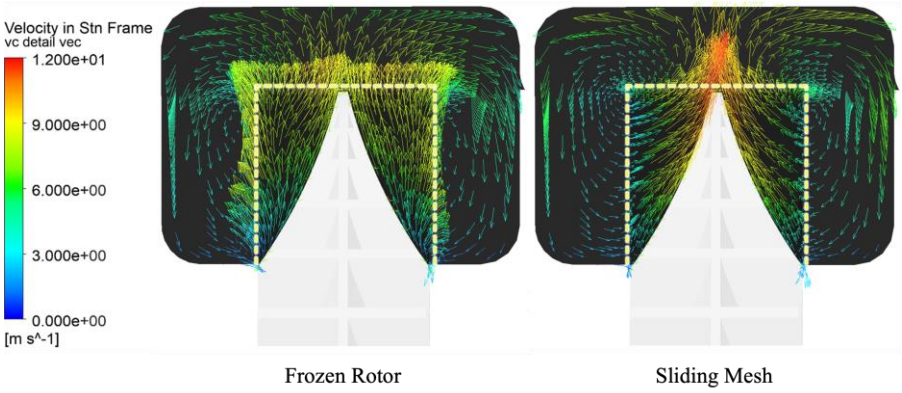

Fig. 3: Flow field around the cascade pump blades

Publications

- Oral Presentations

1) Maiko Yamakawa, Taiga Tokuoka, Yusuke Maru, Shujiro Sawai, Yu Daimon, Takahiro Ito, Yuichi Tsuda, Osamu Mori, DISPERSAL BEHAVIOR OF CELESTIAL SURFACE OBJECTS BY THRUSTER JET, IAC2024, Milan

Usage of JSS

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	OpenMP
Number of Processes	256
Elapsed Time per Case	8.3 Hour(s)

JSS3 Resources Used

Fraction of Usage in Total Resources*1(%): 0.22

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage*2(%)
TOKI-SORA	3,541,487.16	0.16
TOKI-ST	302,292.54	0.31
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	15,330.09	1.11
TOKI-TST	10,141.66	0.18
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	2,094.00	1.41
/data and /data2	195,060.00	0.93
/ssd	31,120.00	1.67

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)	5,380.90	3.68

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