Study on Dynamics of Spacecraft and Space Rocket

Report Number: R21ECWU24
Subject Category: Cooperative Graduate School System
URL: https://www.jss.jaxa.jp/en/ar/e2021/18075/

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Abstract

Fluid phenomena that appears in space rockets and spacecraft was analysed. There are two main subjects; one is design study of air inlet for a reusable ballistic flight rocket equipped with the air breathing engine. The other was to evaluate the interference between the exhaust plume of the thruster and the regolith on the surface of the celestial body, assuming a lunar planet takeoff and landing aircraft.

Reasons and benefits of using JAXA Supercomputer System

It is used for relatively large-scale CFD analysis (aerodynamic design research) and parametric study with a large number of cases (interference evaluation research between exhaust plume and regolith).

Achievements of the Year

Using Ansys Fluent provided by the ISV service, we performed CFD analysis of the injection plume in an experiment in which gas was blown onto simulated soil. The analysis was a steady-state analysis of the axis rotation model, and SST k-w was used as the turbulence model. Figure 1 shows an example calculated for free flow. The experimental results were explained using the physical quantities of the obtained exhaust plume.

We are studying the design of an air intake for a reusable suborbital rocket equipped with an air-breathing engine. Figure 2 shows an example of the analysis results of the air intake alone. In the non-viscous flow, the flow is formed as designed, but in the viscous flow, the deviation from the ideal state is large.

Fig. 1: Density contour (injection pressure: 150kPa, back pressure: 110Pa)

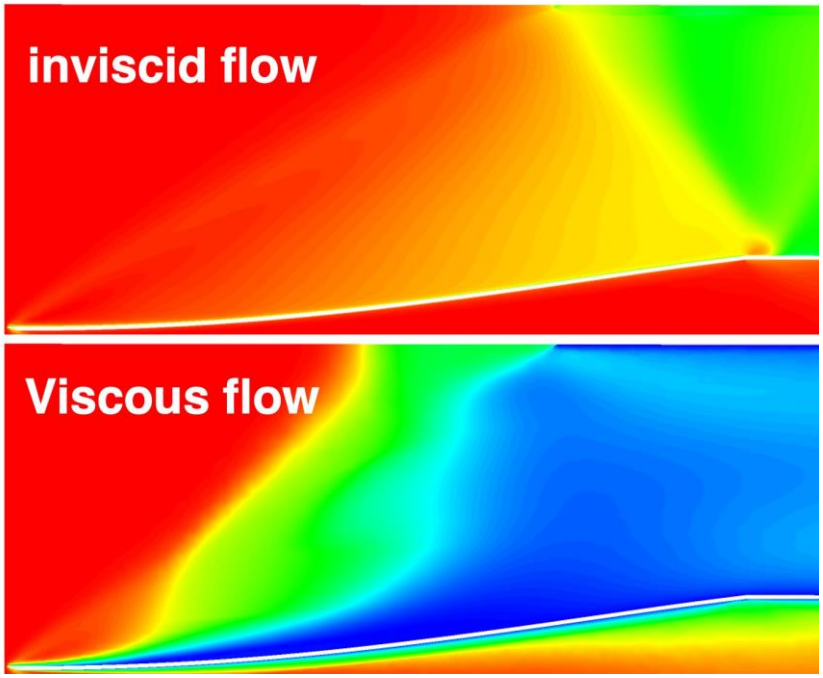

Fig. 2: Examples of results of CFD analyses of air inlet alone configuration

- **Publications**

  N/A

- **Usage of JSS**

- **Computational Information**

Process Parallelization Methods	N/A
Thread Parallelization Methods	Automatic Parallelization
Number of Processes	1
Elapsed Time per Case	5 Hour(s)

- **JSS3 Resources Used**

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

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	65,973.33	0.00
TOKI-ST	18,981.05	0.02
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	700.00	0.70
/data and /data2	11,240.00	0.12
/ssd	1,100.00	0.28

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)	139.62	0.10

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