Liquid-Propellant Propulsion System Simulation

Report Number: R24EG3215
Subject Category: Research and Development
URL: https://www.jss.jaxa.jp/en/ar/e2024/27035/

Responsible Representative

Taro Shimizu, Research and Development Directorate, Research Unit III

Contact Information

Hiedyo Negishi(negishi.hideyo@jaxa.jp)

Members

Ashvin Hosangadi, Yu Daimon, Taroh Fukuda, Osamu Fukasawa, Hideyo Negishi, Takenori Nakajima, Shinji Ohno, Masashi Toyama, Satoshi Ukai, Himeko Yamamoto, Rika Yamada, Andrea Zambon

Abstract

Next generation of space transport systems need not only to reduce costs with high perfoemance propulsion for a particular mission but also to meet requirements of various missions, for example moon lander, reusable upper stage rocket, Mars mission, and so on. Liquid-Propellant System Analysis has an important roll to develop the next generation space transport system. Utilizing 3D numerical simulation results of the liquid rocket compornents, componet models are developed for the system analysis. The system analysis will use for evaluation of the development and operation for liquid rocket or spacecraft.

Reasons and benefits of using JAXA Supercomputer System

Component models of liquid propulsion systems are conventionally very simple and sometimes not consistent with physics of fluid dynamis or structural behaivor of propulsion systems. However, because of the recent development of computer science, even computationally expensive models can be used for numerical analysis for designs. In addition, high-fidelity CFD clarified physical phenomena in the component, and it enhances to develop more accurate component models. Concequently, high-fidelity CFD analyses are essential to clarify the phenomena in the liquid propulsion system. JSS enables us to carry out trade-off studies with a wide range of parameter, which contribute to build new models and find out new insights of liquid propulsion systems.

Achievements of the Year

With regard to JAXA projects such as SLIM, MMX, HTV-X, evaluation of design and risks, studies for improvement as well as understanding physical phenomena were carried out by making full use of the simulation technology of Reserch Unit III and JSS3.

Publications

N/A

Usage of JSS

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	OpenMP
Number of Processes	1440
Elapsed Time per Case	146 Hour(s)

JSS3 Resources Used

Fraction of Usage in Total Resources[*1](%): 0.35

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	8,263,139.76	0.38
TOKI-ST	155,059.45	0.16
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	36.04	0.00
TOKI-TST	65,323.29	1.17
TOKI-TGP	0.00	0.00
TOKI-TLM	326.86	0.87

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage*2 (%)
/home	460.20	0.31
/data and /data2	135,513.44	0.65
/ssd	2,154.03	0.12

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2 (%)
J-SPACE	24.81	0.08

*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)	1,739.31	1.19

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