Liquid-Propellant Rocket System Simulation

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Abstract

Future generation of space transport systems need not only to reduce costs with high propulsion performance but also to meet the requirements of various missions, for example moon landing, reusable upper stage rocket, Mars mission, and so on. Liquid-Propellant Rocket System Analysis has an important role to develop the next generation space transport system. Utilizing 3D numerical simulation results of the liquid rocket compornents, the componet model is developed for the system analysis. The system analysis will be used for evaluation of the development and operation for liquid rocket.

Ref. URL: http://www.kenkai.jaxa.jp/eng/research/software/software.html

Reasons for using JSS2

The liquid rocket component model of the system analysis tool is conventionally very simple. With the development of computer science, even if component models are more complex than before, they can be used for design. In addition, high-fidelity CFD clarified physical phenomena in the component, and it became possible to develop more accurate component models. High-fidelity CFD analysis is essential to clarify the phenomena in the liquid propulsion system, and a wide range of parameter studies that can be used for system analysis are conducted. JSS2 is used for these high-fidelity CFD analysis.

Achievements of the Year

In order to study the flight control plan of the reusable rocket RV-X, the dynamic characteristics of sloshing (moving the center of gravity of the propellant and tank) in consideration of the shape of the accessories in the propellant tank were evaluated using CFD (Fig. 1). We developed a sloshing attenuation model from the CFD

results (Fig. 2) and provide it to the project. It have contributed to the development of a flight control program.

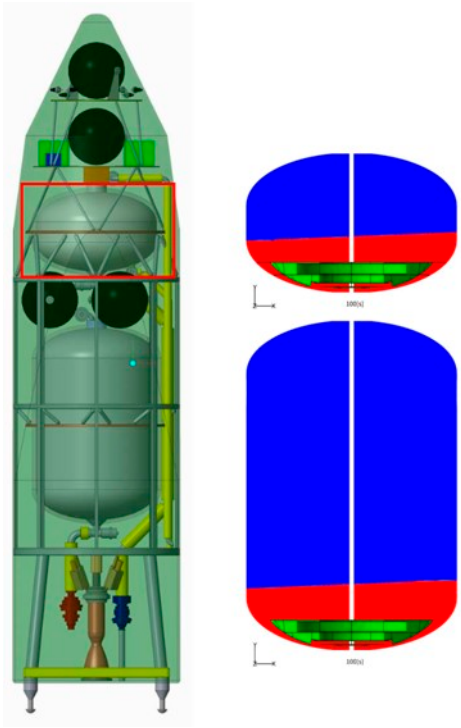

Fig. 1: Reusable rocket RV-X, CFD results of tank sloshing

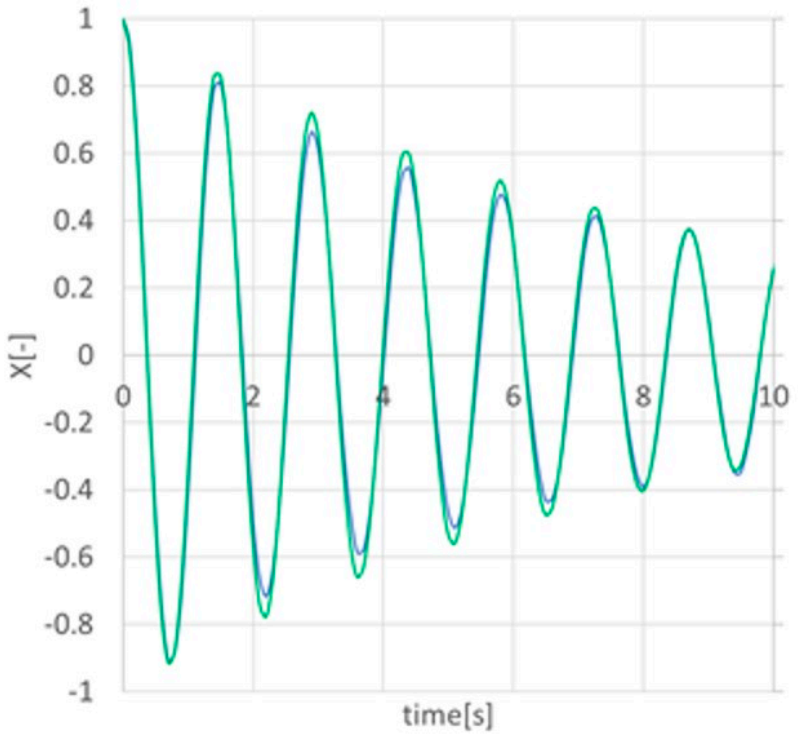

Fig. 2: Time evolution of tank center of gravity

Publications

N/A

Usage of JSS2

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	Automatic Parallelization
Number of Processes	1 - 4
Elapsed Time per Case	150 Hour (s)

Resources Used

Fraction of Usage in Total Resources[*1] (%): 1.22

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage[*2] (%)
SORA-MA	1,384,761.92	0.17
SORA-PP	1,780,416.76	14.23
SORA-LM	335.08	0.16
SORA-TPP	378.39	0.03

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage*2 (%)
/home	638.13	0.66
/data	23,161.66	0.41
/ltmp	13,691.71	1.17

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2 (%)
J-SPACE	0.31	0.01

[*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.