Sloshing Phenomenon under Reduced Gravity

Report Number: R24EDG10103
Subject Category: Research and Development
URL: https://www.jss.jaxa.jp/en/ar/e2024/27162/

Responsible Representative

Masato Sakurai, Manager of ECLSS, Research Unit II, Aerospace R&D Directorate, JAXA

Contact Information

Sakurai Masato(sakaurai.masato@jaxa.jp)

Members

Hikono Furuichi, Motoharu Kusano, Masato Sakurai, Ichiro Ueno

Abstract

In December 2022, a series of experiments on liquid behavior in low gravity environments (LBPGE) simulated with CBEF were conducted on the ISS. The objective of this study is to elucidate sloshing phenomena in a small sealed vessel in order to accumulate knowledge on liquid behavior in a low gravity environment.

Reasons and benefits of using JAXA Supercomputer System

In discussing sloshing phenomena, it is necessary to reproduce complex interfacial behavior. Large-scale computational resources are essential to study these phenomena on Earth, and the use of JSS makes it possible to perform a huge number of calculations at high speed.

Achievements of the Year

We constructed a numerical model with the same dimensions as the small container used in the LBPGE experiment and worked to elucidate the effect of the liquid containment on the liquid behavior observed in the on-orbit experiment. The results are shown below. When the container was oscillated at the first-order resonance frequency in ground gravity, a resonance phenomenon occurred when the initial liquid level was 9.33 mm, but not when the initial liquid level was 7.34 mm. This indicates that the presence or absence of the resonance phenomenon when the container was oscillated at the resonant frequency depended on the initial liquid level in the container. (Fig. 1)

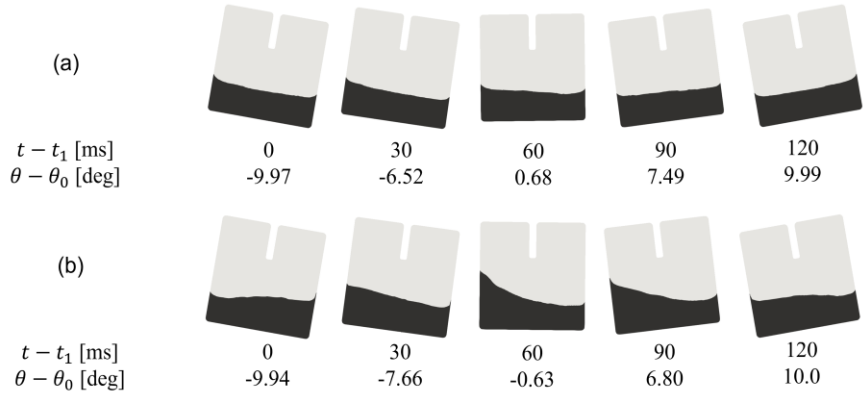

Fig. 1: Liquid behavior at first-order resonant frequency (initial liquid level (a) 7.50 mm (b) 8.50 mm)

Publications

- Poster Presentations

Effect of initial liquid height on sloshing in closed vessel, JASMAC-36

On fluid behavior in gas-liquid two-phase flow in low gravity for manned space exploration, Ukaren68

Usage of JSS

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	OpenMP
Number of Processes	144 - 324
Elapsed Time per Case	72 Hour(s)

- **JSS3 Resources Used**

Fraction of Usage in Total Resources[*1](%): 1.03

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	0.00	0.00
TOKI-ST	8,964,300.65	9.20
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	519.98	0.04
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	245.00	0.17
/data and /data2	201,915.00	0.97
/ssd	7,530.00	0.40

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[*2] (%)
J-SPACE	2.73	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.

- **ISV Software Licenses Used**

ISV Software Licenses Resources		
	ISV Software Licenses Used (Hours)	Fraction of Usage[*2] (%)
ISV Software Licenses (Total)	1.35	0.00

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