

Research of Multi-Physics Simulation Technology

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● Abstract

The purpose of this research is to obtain the simulation technology to analyze phenomena relating with multi-physics such as acoustic fluid dynamics and multi-phase flows.

● Reasons and benefits of using JAXA Supercomputer System

JSS2 was used to conduct the simulation of liquid with a particle method, which needs the resource of JSS2 to deal with tens of millions particles in a large computational domain.

● Achievements of the Year

Water spray generated from a tire of an aircraft running on flooded runway was simulated using explicit MPS method. By considering aerodynamic force evaluated with a model developed in last year, it was found that the distribution of the water spray got close to the experimental data. Also, the jet break up problem was simulated as validation of the aerodynamic model, and methodology of coupling simulation between P-Flow and FaSTAR was investigated.

● Publications

- Oral Presentations

1)S. Koga, K. Kubota, Y. Iijima, S. Koike, K. Nakakita: Quasi-Full-Scale Test for Prediction Technology of Water Spray Generated by Aircraft Tire, Proceedings of the Fluid Dynamics Conference/Aerospace Numerical Simulation Symposium 2020 Online, 2A05, 2020.

2)H. Tsujimura, K. Kubota, T. Sato: Numerical Analysis of Water Spray from Firefighting Aircraft Using Grid and Particle Methods Coupled by the Aerodynamic Force Model, Proceedings of the Fluid Dynamics Conference/Aerospace Numerical Simulation Symposium 2020 Online, 2A06, 2020.

3) M. Orszynowicz, H. Amano, K. Kubota, T. Miyajima: Exploiting temporal parallelism in particle-based incompressible fluid simulation on FPGA, CANDAR2020, 102, 2020.

4) T. Takahashi, H. Ura, K. Okubo, T. Tsuchiya: Numerical Analysis and Measurement Techniques for Aircraft Cabin Noise Using JAXA's Jet-FTB "HISHO", Proceedings of the Fluid Dynamics Conference/Aerospace Numerical Simulation Symposium 2020 Online, 2A07, 2020.

5) T. Ikeda: Accuracy Verification for the Inhomogeneous Wave Equation Discretized by a Finite Difference Scheme on Homogeneous Cartesian Grid, Proceedings of the Fluid Dynamics Conference/Aerospace Numerical Simulation Symposium 2020 Online, 1A06, 2020.

● Usage of JSS

● Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	N/A
Number of Processes	80 - 144
Elapsed Time per Case	10 Hour(s)

- **Resources Used(JSS2)**

Fraction of Usage in Total Resources*1(%): 0.93

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage*2(%)
SORA-MA	1,171,365.26	0.22
SORA-PP	1,266,711.90	9.93
SORA-LM	677.21	0.40
SORA-TPP	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage*2(%)
/home	1,187.41	1.09
/data	11,610.04	0.22
/ltmp	10,400.40	0.89

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2(%)
J-SPACE	5.66	0.19

*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.

- **Resources Used(JSS3)**

Fraction of Usage in Total Resources^{*1}(%): 0.36

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage ^{*2} (%)
TOKI-SORA	389,781.57	0.08
TOKI-RURI	325,429.67	1.86
TOKI-TRURI	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage ^{*2} (%)
/home	1,194.25	0.82
/data	18,249.07	0.31
/ssd	386.35	0.20

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage ^{*2} (%)
J-SPACE	5.66	0.19

^{*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.