

## 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 for using JSS2

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. The resources was also used to improve the aerodynamic force model acting on a droplet from air stream.

### ● Publications

- Peer-reviewed papers

1) H. Tsujimura, K. Kubota, T. Sato, T. Takahashi, K. Murakami: Modeling of Aerodynamic Force for Numerical Analysis of Liquid Droplets using Particle Method, Nagare, to be published. (in Japanese)

2) Akihiro Fukuda, Kan Okubo, Takuya Oshima, Takao Tsuchiya and Masashi Kanamori, Numerical Analysis of Three-dimensional Acoustic Field with Background Flow Using Constrained Interpolation Profile (CIP) Method, Japanese Journal of Applied Physics, Vol. 57, Number 7S1, 2018

- Oral Presentations

1) K. Kubota, N. Fujita: Development of Particle Simulation Code P-Flow and Feasibility Study for Water Spray on Flooded Runway, 32nd CFD Symposium, 2018. (in Japanese)

2) K. Kubota, N. Fujita: Development of Liquid Simulator P-Flow using Particle Method and Acceleration with OpenACC, GTC Japan, 2018.

3) Takashi Takahashi, Research activities on numerical acoustic transmission analysis for solving issues of the aerospace industry, 2nd NVH committee, society of automotive engineers of Japan, Inc., 2018.

4) Tomoaki Ikeda, The inhomogeneous wave equation solved on Cartesian grid, 50th Fluid Dynamics Conference/36th Aerospace Numerical Simulation Symposium, 2018.

5) K. YAMADA, Y. Ohmichi, and K. Suzuki, “Global Stability Analysis of Vortex Breakdown in Misaligned Compressible Swirling Jet,” 71st Annual Meeting of the APS Division of Fluid Dynamics, Atlanta, Georgia, 2018.

● Usage of JSS2

● Computational Information

|                                 |              |
|---------------------------------|--------------|
| Process Parallelization Methods | MPI          |
| Thread Parallelization Methods  | N/A          |
| Number of Processes             | 8 - 175      |
| Elapsed Time per Case           | 9.5 Hour (s) |

● Resources Used

Fraction of Usage in Total Resources\*1 (%): 0.84

Details

| Computational Resources |                                       |                         |
|-------------------------|---------------------------------------|-------------------------|
| System Name             | Amount of Core Time<br>(core x hours) | Fraction of Usage*2 (%) |
| SORA-MA                 | 7,003,543.41                          | 0.86                    |
| SORA-PP                 | 112,104.62                            | 0.90                    |
| SORA-LM                 | 7,642.17                              | 3.56                    |
| SORA-TPP                | 0.00                                  | 0.00                    |

| File System Resources |                        |                         |
|-----------------------|------------------------|-------------------------|
| File System Name      | Storage Assigned (GiB) | Fraction of Usage*2 (%) |
| /home                 | 885.84                 | 0.92                    |
| /data                 | 18,545.70              | 0.33                    |
| /ltmp                 | 7,521.86               | 0.64                    |

| Archiver Resources |                    |                         |
|--------------------|--------------------|-------------------------|
| Archiver Name      | Storage Used (TiB) | Fraction of Usage*2 (%) |
| J-SPACE            | 7.04               | 0.25                    |

\*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.