Research of Multi-Physics Simulation Technology

● **Responsible Representative**

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● **Abstract**

The purpose of this research is to obtain the simulaiton technology to analyze phenomana 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 simulaiton 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 results show that the accuracy of spray's angle can be improved by considering the deformation of the tire. The resources was also used to improve the aerodynamic force model acting on a droplet from air stream, and improvement of the accurary was confirmed through comparison with other simulation method such as VOF.

● **Publications**

- Peer-reviewed papers

1) H. Tsujimura, K. Kubota, T. Sato: Development of Aerodynamic Force Model Based on Potential Flow for Liquid Droplets Analyzed by Particle Method, Transaction of JSASS, to be published.

2) IkedaTomoaki, Acoustic Propagation Prediction Using the Inhomogeneous Wave Equation on the Cartesian Grid, The 11th Asia-Pacific International Symposium on Aerospace Technology 2019.

3) Hirai Shiku, Fukushima Yuma, Ohbayashi Shigeru, Misaka Takashi,Daisuke Sasaki, Ohmichi Yuya, Kanamori Masashi,and Takahashi Takashi, Influence of Turbulence Statistics on Stochastic Jet-Noise Prediction with Synthetic Eddy Method, J. of Aircraft, Vol.56, No.6, 2019.

- Non peer-reviewed papers

1)K. Kubota, S. Koga, Y. Iijima, S. Koike, K. Nakakita: Research on Prediction Technology of Water Spray Generated from Aircraft Tire, JAXA Special Publication: Proceedings of the 51st Fluid Dynamics Conference / the 37th Aerospace Numerical Simulation Symposium, JAXA-SP-19-007, 2019.

- Oral Presentations

1) K. Kubota, H. Tsujimura, T. Sato: Particle Simulation of Water Spray Generated from Tire of Aircraft, Proceedings of the Conference on Computational Engineering and Science, Vol.24, 2019.

2) K. Kubota, S. Koga, Y. Iijima, S. Koike, K. Nakakita: Research on Prediction Technology of Water Spray Generated from Aircraft Tire, Proceedings of the 51st Fluid Dynamics Conference / the 37th Aerospace Numerical Simulation Symposium, 1A17, 2019.

3) H. Tsujimura, K. Kubota, T. Sato: Development of Aerodynamic Force Model Based on Potential Flow for Liquid Droplets Analyzed by Particle Method, 32nd International Symposium on Space Technology and Science, 2019-e-39, 2019.

4)Ikeda Tomoaki,For the Practical Computations of Acoustic Propagation Using the Inhomogeneous Wave Equation, 51st Fluid Dynamics Conference/37th Aerospace Numerical Simulation Symposium, 2019.

5)Takahashi Takashi,Ura Hiroki, Ikeda Tomoaki, Okubo Kan, and Tsuchiya Takao, Study on Numerical Analysis and Measurement Techniques of Aircraft Interior and Exterior Noise in ISSAC, 51st Fluid Dynamics Conference/37th Aerospace Numerical Simulation Symposium, 2019.

● **Usage of JSS2**

● **Computational Information**

Process Parallelization Methods	MPI
Thread Parallelization Methods	N/A
Number of Processes	80 - 200
Elapsed Time per Case	10 Hour(s)

- **Resources Used**

Fraction of Usage in Total Resources[1](%): 1.09

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage[2](%)
SORA-MA	7,187,182.41	0.87
SORA-PP	763,903.44	4.95
SORA-LM	1,833.71	0.77
SORA-TPP	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage[2](%)
/home	593.07	0.49
/data	13,899.40	0.24
/ltmp	8,579.80	0.73

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[2](%)
J-SPACE	7.04	0.18

[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.