Research on Particle-based Fluid Simulation Method for Improvement of Design and Development in Aeronautics

Report Number：R17EA1907
Subject Category：Aeronautical Technology
URL：https://www.jss.jaxa.jp/ar/e2017/4376/

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Abstract

In this project, a numerical code using particle method, which is known to be a meshless method to simulate fluid governed by Navier-Stokes equation, is being developed, and we investigate applicability of particle methods to aeronautics, especially the improvement in design and development of aircrafts.

Reasons for using of JSS2

We used JSS2 to reduce computation time, because the computational cost of the particle method is known to be higher than grid methods. Parallel computing is effective on the reduction of computation time, and massive parallel computation on a super computer is planned in future studies.

Achievements of the Year

For developing a numerical simulation method of water drops exposed to airflow, a model to simulate aerodynamic force acting on a droplet composed of many particles was developed and implemented to the developing code. We simulated droplet breakup and compared the results with the breakup patterns which is known to be classified by the initial Weber. As a result, it was found that the characteristic behavior such as no-breakup in the low Weber number about 10 and sheet stripping in high Weber number about 150 can be captured with the developed model, whereas bag and bag-and-stamen breakup did not appear in the middle Weber number. Therefore, it can be said that the developed dynamic pressure model is applicable to the droplet exposed in the airflow for the Weber number above 150.

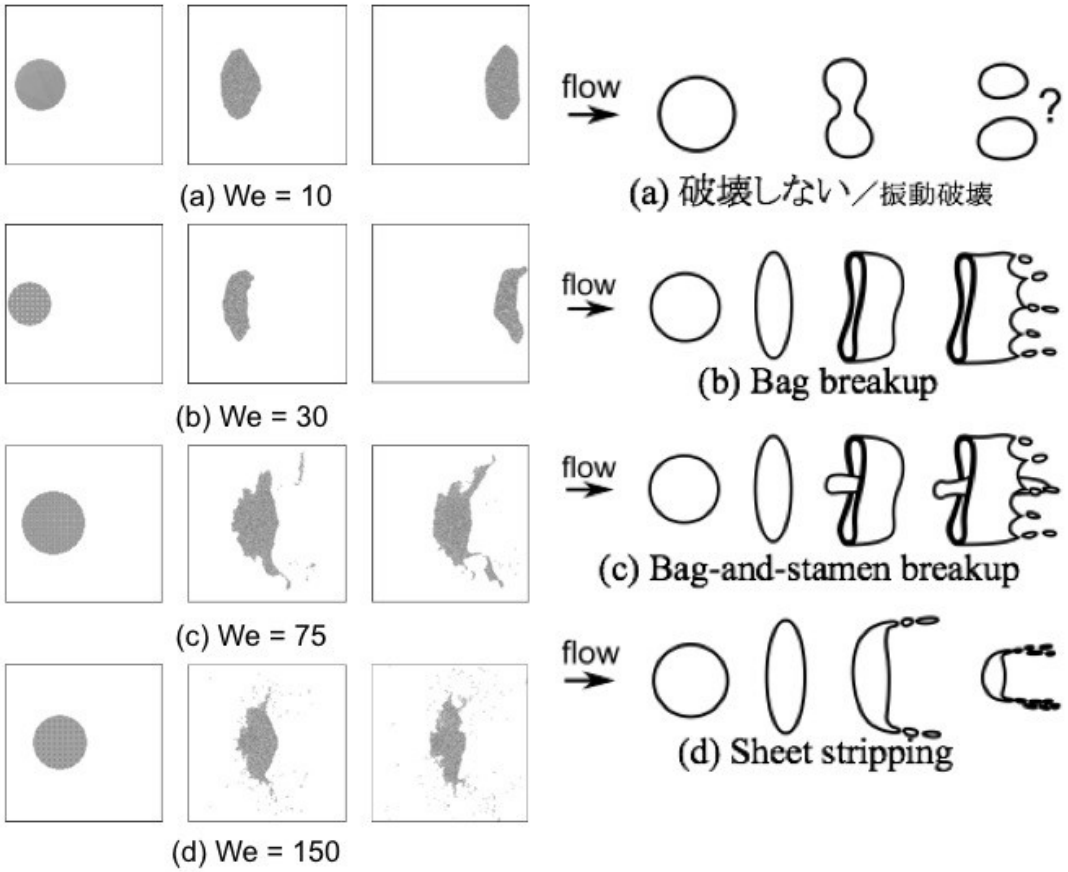

Fig.1 Result of numerical analysis for four Weber numbers (left) and experimentally known breakup patterns (right).

Publications

- Presentations

1) Hiroki Tsujimura, Kenichi Kubota, Tetsuya Sato, Takashi Takahashi, Keiichi Murakami, "Numerical Model using MPS method on Droplet Breakup in Streaming Air", 31st Symposium on Computational Fluid Dynamics, D09-3, 2017.

Usage of JSS2

Computational Information

Parallelization Methods	MPI
Thread Parallelization Methods	N/A
Number of Processes	2 - 4
Elapsed Time per Case	1.00 minutes

Resources Used

Fraction of Usage in Total Resources*1 (%): 0.00

Details

Computing Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage*2 (%)
SORA-MA	0.00	0.00
SORA-PP	621.94	0.01
SORA-LM	0.00	0.00
SORA-TPP	0.00	0.00

File System Resources		
File System Name	Storage assigned(GiB)	Fraction of Usage*2 (%)
/home	014.62	0.01
/data	146.23	0.00
/ltmp	2,994.79	0.23

Archiver Resources		
Archiver System Name	Storage used(TiB)	Fraction of Usage*2 (%)
J-SPACE	0.00	0.00

*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