Construction of LES Model for High Mach-number-turbulent-multi-phase-flow model based on DNS

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Responsible Representative

Kota Fukuda, Tokai University

Contact Information

Kota Fukuda　fukuda@tokai-u.jp

Members

Kota Fukuda

Abstract

In order to construct LES model for high Mach number multi-phase turbulent flow, direct numerical simulation (DNS) of high Mach number and low Reynolds number flow around a particle will be carried out and construction of its data base and examination of the flow phenomena will be conducted.

Reasons for using of JSS2

In this project, direct numerical simulation (DNS) of high Mach number and low Reynolds number flow around a particle and construction of the data base will be carried out using a boundary-fitted coordinate system. Large scale numerical simulation is essential to construct the data base.

Achievements of the Year

The characteristics of flow around a particle at a Reynolds number between 500 and 1000 and a Mach number between 0.8 and 2.0, such as drag coefficient, flow pattern, and Strouhal number were examined. Furthermore, effects of temperature and rotation were also investigated.

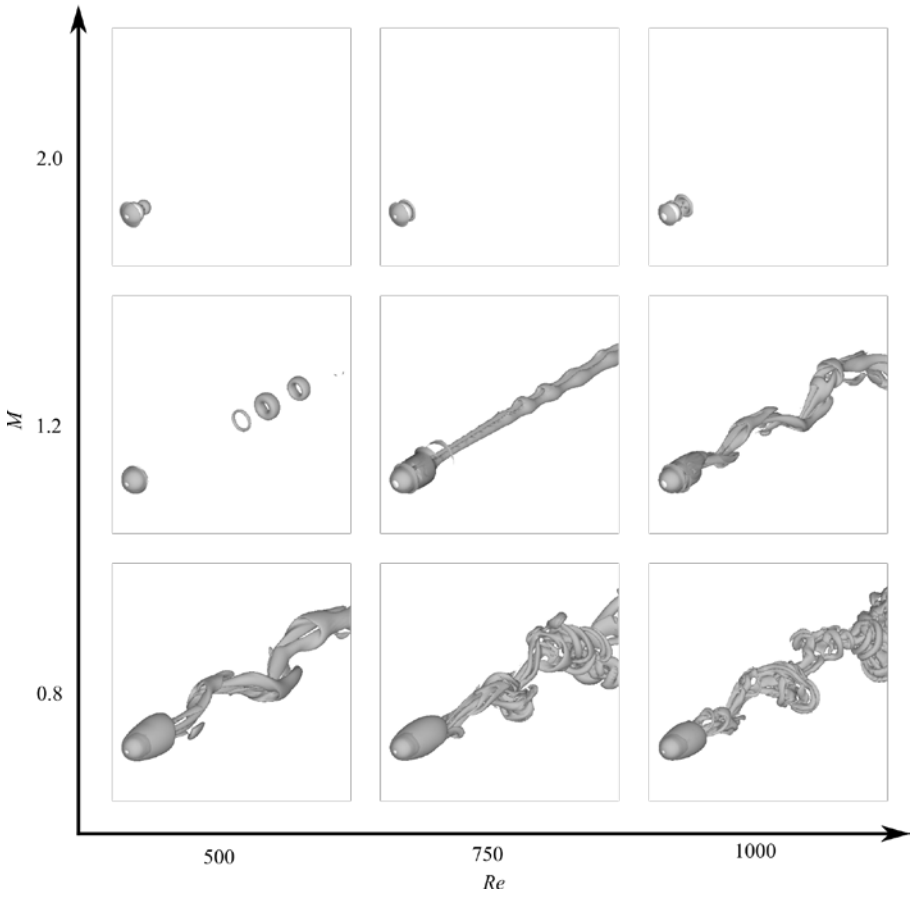

Fig.1 Vortex structure identified by the isosurface of second invariant value of the velocity gradient tensor.

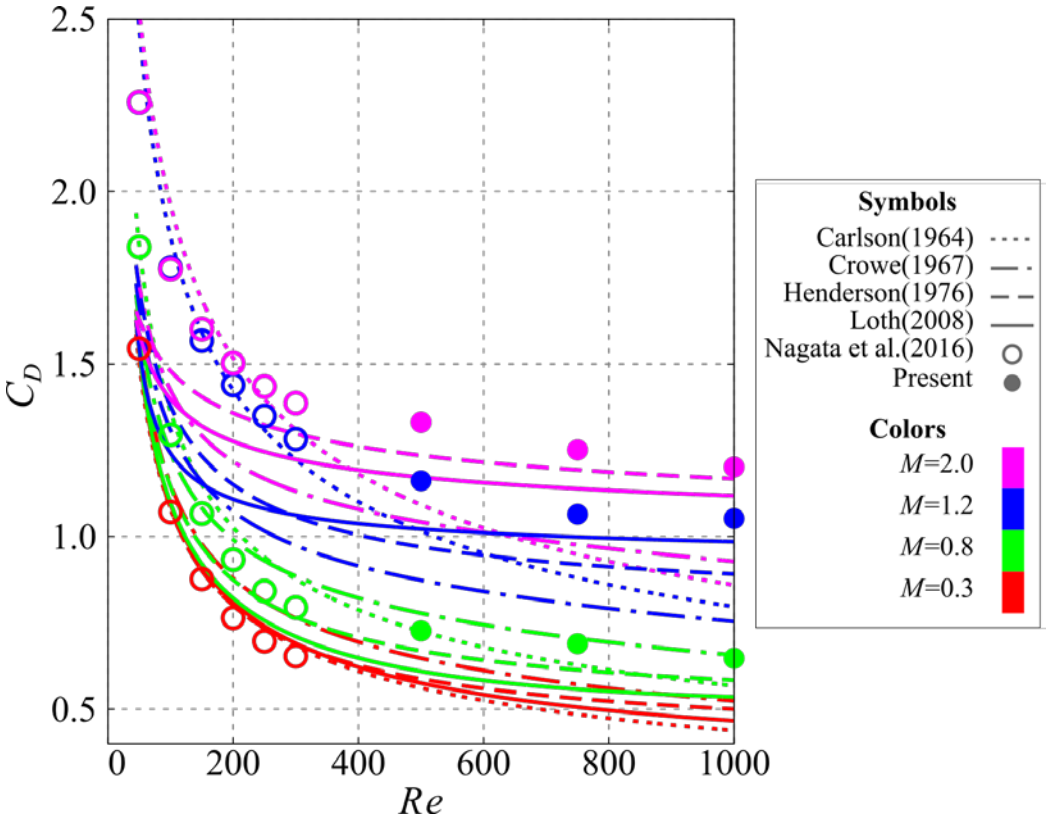

Fig.2 Relationship between Reynolds number and drag coefficient.

Publications

- Peer-reviewed papers

1) Nagata, T., Nonomura, T., Takahashi, S., Mizuno, Y., and Fukuda, K, "Direct Numerical Simulation of Flow around a Heated/Cooled isolated Sphere up to a Reynolds Number of 300 under Subsonic to Supersonic Conditions," International Journal of Heat and Mass Transfer, Vol. 120, pp. 284-299, 2018.

- Presentations

1) Nagata, T., Nonomura, T., Takahashi, S., Mizuno, Y., and Fukuda, K, "Direct numerical simulation of flow past a sphere at a Reynolds number between 500 and 1000 in compressible flows," 56th AIAA Aerospace Sciences Meeting, Gayload Parms, Florida. January 2018.
2) Kuribayashi, T., Hamagata, Y., Mizuno, Y., Takahashi, S., Nonomura, T., Nagata, T., and Fukuda, K. "Investigation of Heat Transfer for a Flow around a Sphere in Cartesian Mesh by using Immersed Boundary Method," MNTC International Symposium 2017, P123, Tokai University, Kanagawa, Japan, August, 2017.

Usage of JSS2

Computational Information

Parallelization Methods	MPI
Thread Parallelization Methods	OpenMP
Number of Processes	169 - 289
Elapsed Time per Case	200.00 hours

Resources Used

Fraction of Usage in Total Resources*1 (%): 0.33

Details

Computing Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage*2 (%)
SORA-MA	2,671,845.29	0.35
SORA-PP	0.00	0.00
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	039.34	0.03
/data	19,683.85	0.36
/ltmp	2,075.20	0.16

Archiver Resources		
Archiver System Name	Storage used(TiB)	Fraction of Usage*2 (%)
J-SPACE	9.97	0.43

*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