Computational Study on Aerodynamic Characteristics of Slender Body Configurations

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Abstract

We conducted numerical analysis on a slender body configuration which mimics a reusable rocket. In this study, we acquired detailed flowfields which have not been obtained from previous experiments and related them with aerodynamic characteristics. We also investigated and clarified effects of aerodynamic devices such as fins and canards on the aerodynamic characteristics.

http://www.aero.ynu.ac.jp/index_en.html

Reasons for using of JSS2

From earlier studies, it is known that our calculations require at least 10 million cells. In order to reduce the computational time of such large-scale calculations significantly, we used JSS2.

Achievements of the Year

We conducted numerical simulations on a slender body configuration which mimicked a reusable rocket. From results, we found that pitching moment coefficients changed by installing canards or fins in the vehicle (Fig.1). In addition, from visualization results, it was revealed that flowfields on the leeward side of the vehicle are affected by such aerodynamic devices (Figs.2 and 3). As a result, we clarified the relationship between aerodynamic characteristics and flowfields.
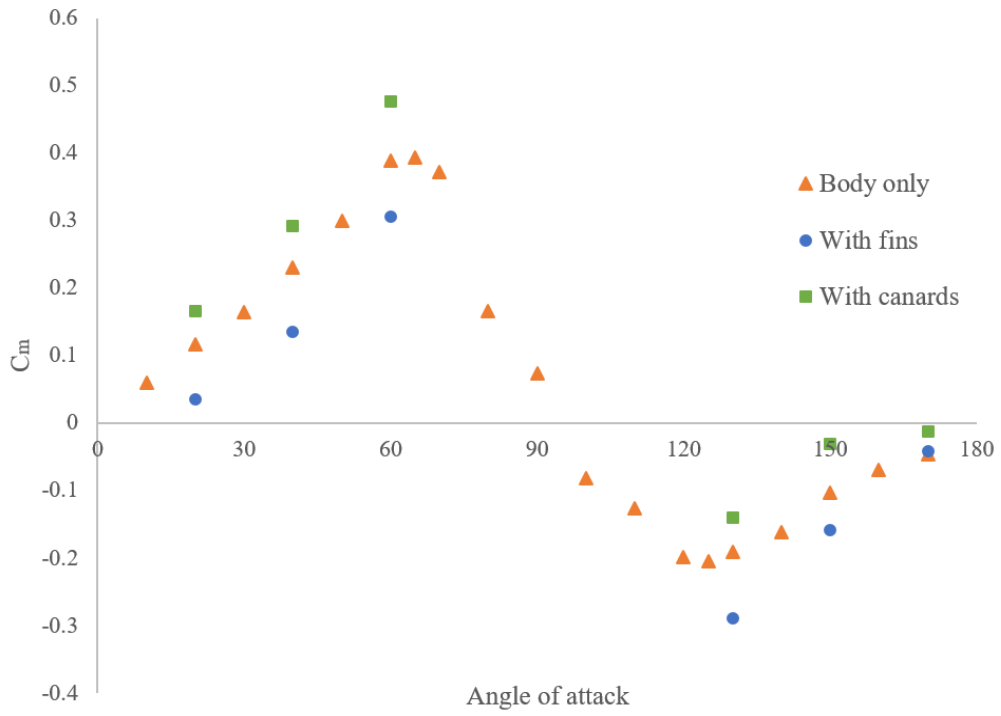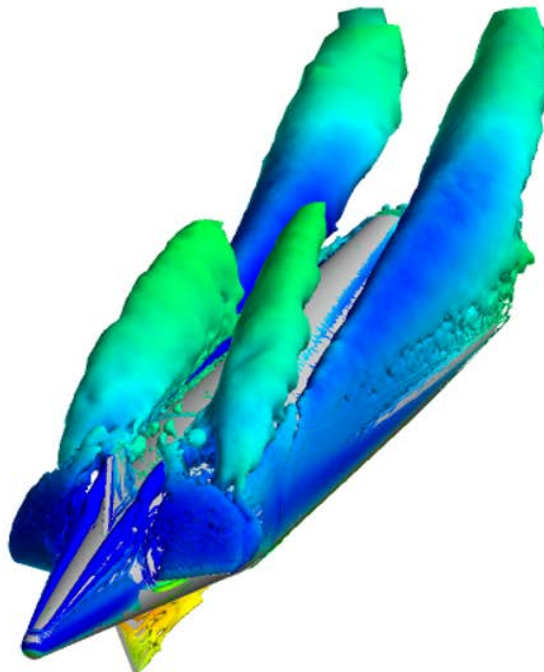
Fig.1 Pitching moment coeficients
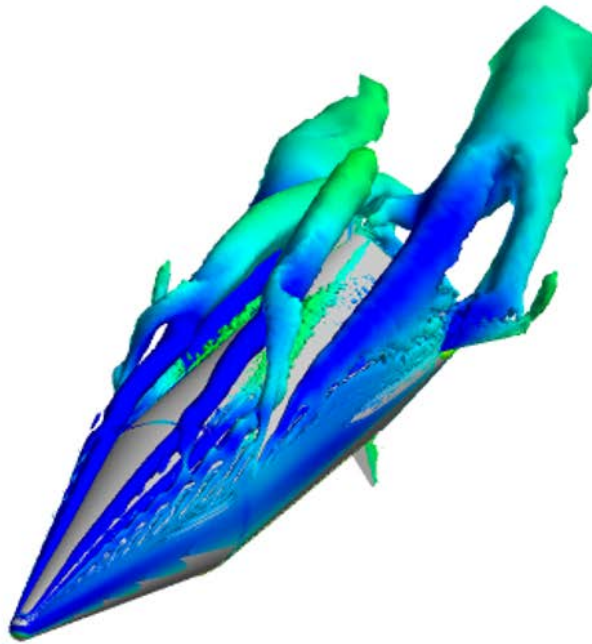

Fig.2 Q isosurface (canards, 40 degrees of AOA)

Fig.3 Q isosurface (fins, 40 degrees of AOA)

Publications

- Peer-reviewed papers

1) Aogaki T., Kitamura K., and Nonaka S., "Computational Study on Finned Reusable Rocket Aerodynamics during Turnover", Transactions of the Japan Society for Aeronautical and Space Sciences. (Accept)

- Presentations

1) Aogaki T., Kitamura K., and Nonaka S., "Computational Study on Finned Reusable Rocket Aerodynamics during Turnover", 31st International Symposium on Space Technology and Science, 2017-o-3-04, Matsuyama, June 2017.

🔵 Usage of JSS2

● Computational Information

Parallelization Methods	MPI
Thread Parallelization Methods	N/A
Number of Processes	128 - 1024
Elapsed Time per Case	30.00 hours

● Resources Used

Fraction of Usage in Total Resources*1 (%): 0.20

Details

Computing Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage*2 (%)
SORA-MA	1,413,528.60	0.19
SORA-PP	9,364.05	0.12
SORA-LM	15,468.60	7.97
SORA-TPP	0.00	0.00

File System Resources		
File System Name	Storage assigned(GiB)	Fraction of Usage*2 (%)
/home	007.15	0.00
/data	071.53	0.00
/ltmp	1,464.84	0.11

Archiver Resources		
Archiver System Name	Storage used(TiB)	Fraction of Usage*2 (%)
J-SPACE	0.62	0.03

*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