

Study on Aerodynamics of Space Plane

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Subject Category : Skills Acquisition System

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● Abstract

Conducting aerodynamic design and evaluation of aerodynamic characteristics on space plane carrying amor breathing engines with CFD simulations.

● Reasons for using of JSS2

Simulation environment is arranged well. And also, CFD software is substantial.

● Achievements of the Year

CFD simulations have been carried out using "Fluent".

In order to confirm the validity of CFD, CFD simulation was performed on the shape of which wind tunnel experiment was performed and the results were compared. A consistent result was obtained for lift and drag. (fig.1)

We are considering to apply the concept of wave rider to the aerodynamic shape of space planes. In wave rider, we considered improvement of performance at non-design Mach number by changing aerodynamic shape, and evaluated its effect and characteristics by CFD. By bending the tip of the wing to approach the shock wave surface, we considered to improve the performance below the design Mach number, however the performance did not change very much. While, it showed that the performance can be improved at above design Mach number by contracting the wings. (fig.2)

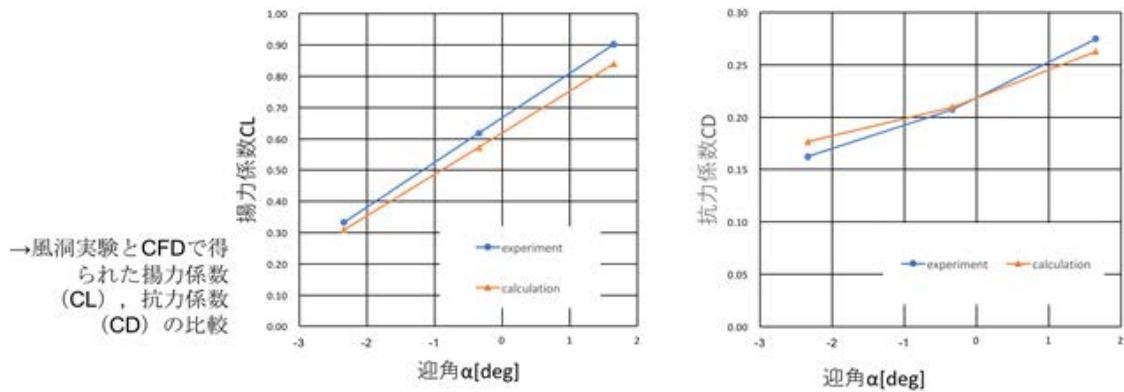
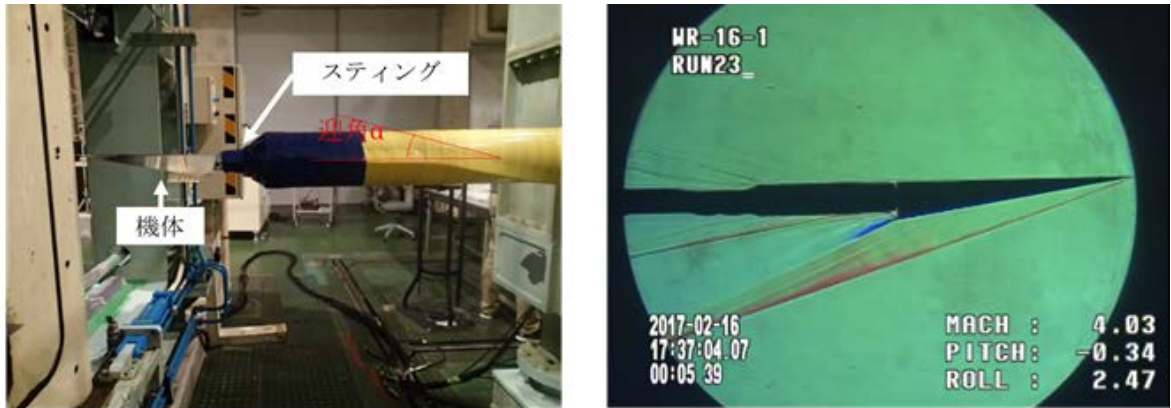


Fig.1 Comparison in lift and drag coefficients between experiment and CFD

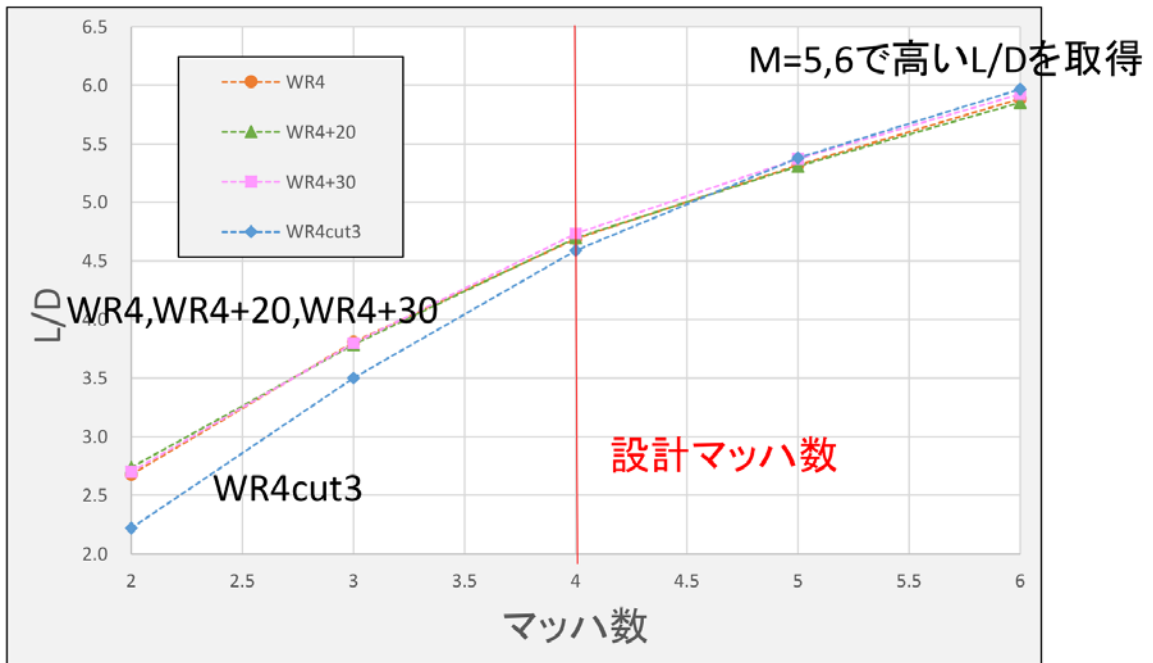


Fig.2 effect of aerodynamic shape deformation on lift-drag ratio

衝撃波面と翼端の距離

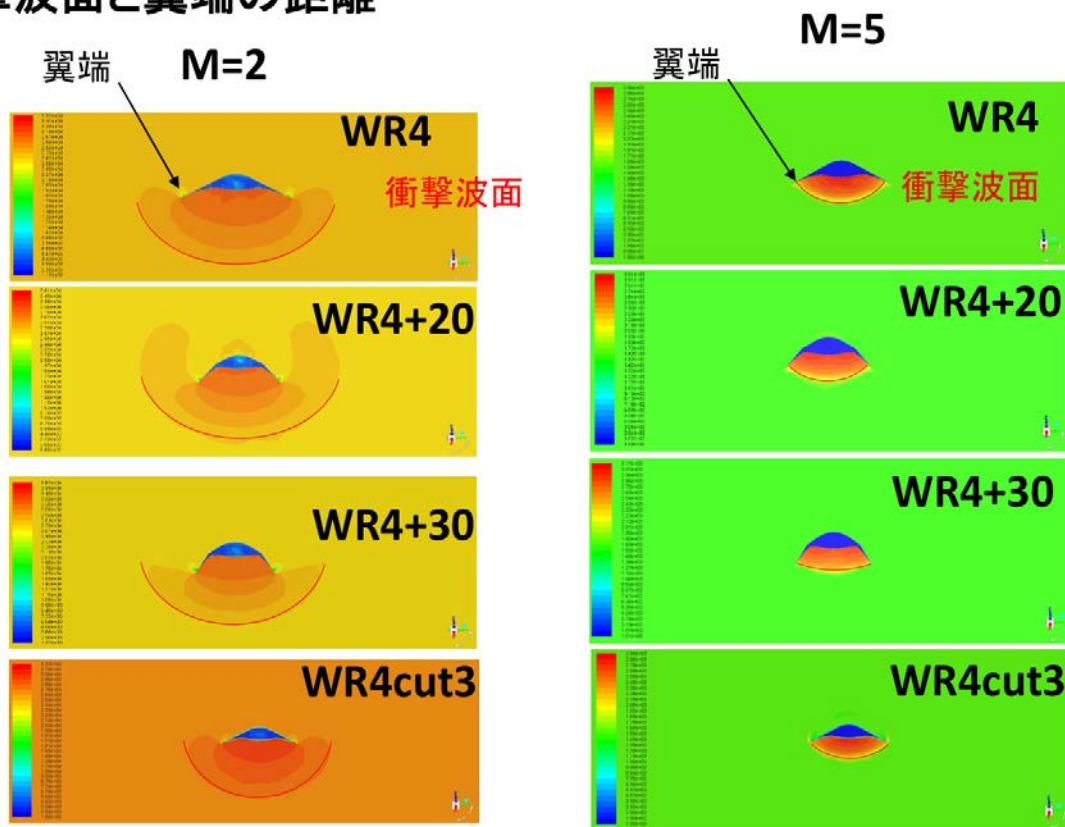


Fig.3 relationship between shock wave surface and wing tip

● Publications

● Presentation

- 1) Mafuyu Imai, Hiroyasu Manako, Yusuke Maru, Shujiro Sawai, "Study on improvement of off-design performance of wave riders by aerodynamic shape deformation", 61st UKAREN, 2J14, Niigata, 2017/10
- 2) Mafuyu Imai, Hiroyasu Manako, Yusuke Maru, Shujiro Sawai, "Study on off-design aerodynamic performance of wave riders", Symposium on dynamics for space flight 2017, Sagamihara, 2017/12

● Others

- 1) Mafuyu Imai, Study on aerodynamic performance of space planes, Master's thesis, Teikyo University, 2018

● Usage of JSS2

● Computational Information

Parallelization Methods	N/A
Thread Parallelization Methods	N/A
Number of Processes	1
Elapsed Time per Case	10.00 hours

● 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	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	019.07	0.01
/data	190.73	0.00
/ltmp	3,906.25	0.29

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