Numerical Analyses on Hypersonic Experimental Aircraft

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● **Abstract**

This research aims at the demonstration of the thrust control method of a hypersonic pre-cooled turbojet engine using liquid hydrogen fuel and the aircraft / propulsion integrated control method. We acquire the control characteristics of the hypersonic integrated control experiment aircraft to establish the aircraft / propulsion integrated control method taking into account the mutual interference of hypersonic airframe and hypersonic engines. In addition to defining the required specifications of hypersonic aircraft, we present the design specifications of the hypersonic experimental aircraft for carrying out flight demonstration of hypersonic pre-cooled turbojet engine.

● **Reasons and benefits of using JAXA Supercomputer System**

We need a long calcularion time to obtaine the aerodynamic characteristics of the overall hypersonic experimental aircraft by CFD analyses.

● **Achievements of the Year**

The influence of the aerodynamic characteristics of the nose shape of the Mach 5 class High Mach Integrated Control Experimental Aircraft (HIMICO) was evaluated using CFD.
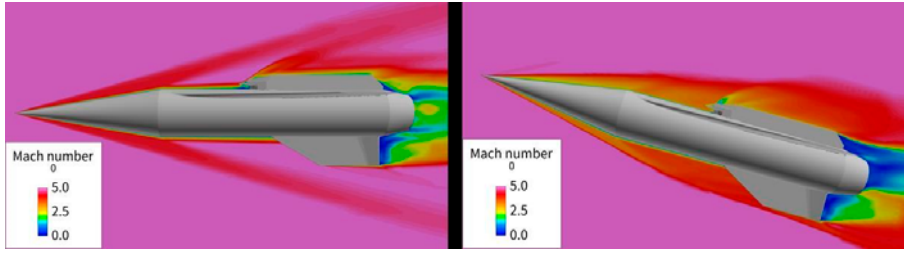
Fig. 1: High Mach Integrated Control Experimental Aircraft   (HIMICO)

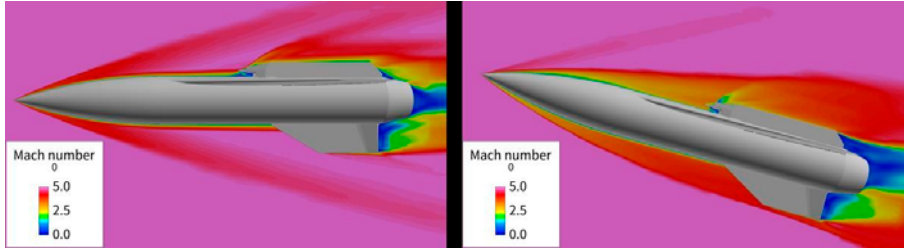(Mach Contour, Conical nose, Mach5, AoA = 0deg, -15deg)

Fig. 2: High Mach Integrated Control Experimental Aircraft (HIMICO)   (Mach

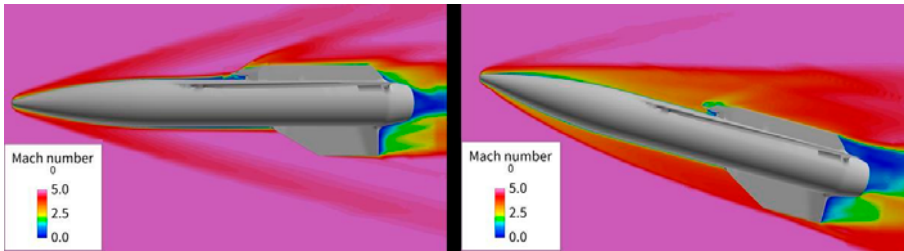Contour, Ogive nose, Mach5, AoA = 0deg, -15deg)

Fig. 3: High Mach Integrated Control Experimental Aircraft (HIMICO) (Mach

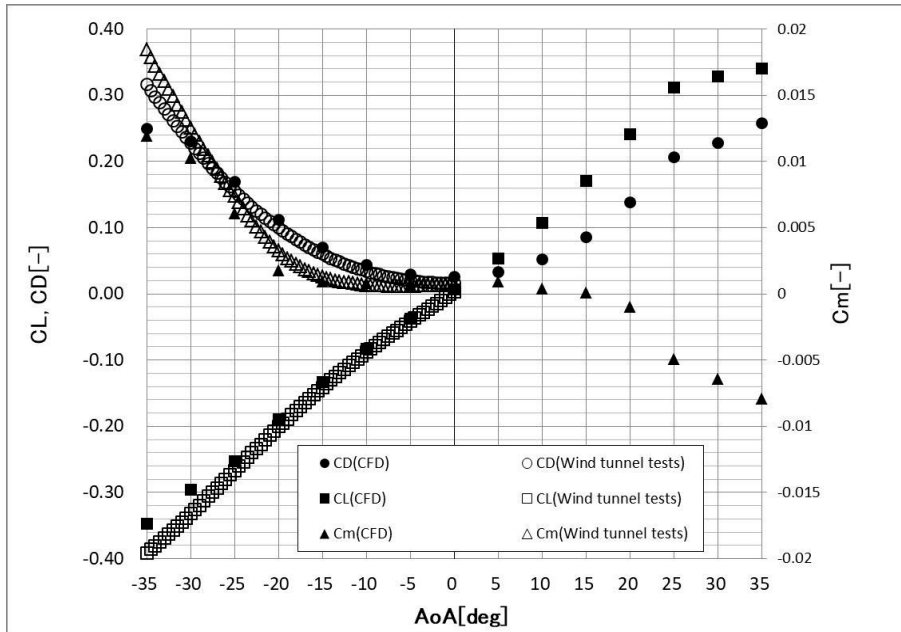Contour, Parabolic nose, Mach5, AoA = 0deg -15deg)

Fig. 4: High Mach Integrated Control Experimental Aircraft (HIMICO)

(Longitudinal Three-Component Force Compared with Wind Tunnel Test,

Mach5)

Publications

- Non peer-reviewed papers

Hiroyuki Tanaka , Tomonari Hirotani, Hideyuki Taguchi , Asei Tezuka ,Aerodynamic Characteristics on Effect of Nose Shape for High-Mach Integrated Control Experimental Aircraft (HIMICO), 58th Aircraft Symposium, 2020.

- Oral Presentations

Hiroyuki Tanaka , Tomonari Hirotani, Hideyuki Taguchi , Asei Tezuka ,Aerodynamic Characteristics on Effect of Nose Shape for High-Mach Integrated Control Experimental Aircraft (HIMICO), 58th Aircraft Symposium, 2020.

Usage of JSS

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	OpenMP
Number of Processes	1 - 2
Elapsed Time per Case	30 Hour(s)

● **Resources Used(JSS2)**

Fraction of Usage in Total Resources[*1](%): 8.29

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage[*2](%)
SORA-MA	50,141,303.16	9.49
SORA-PP	13,622.01	0.11
SORA-LM	10,561.36	6.20
SORA-TPP	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage[*2](%)
/home	1,478.20	1.35
/data	44,565.22	0.86
/ltmp	15,625.01	1.33

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[*2](%)
J-SPACE	2.10	0.07

[*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.

● **Resources Used(JSS3)**

Fraction of Usage in Total Resources[*1](%): 0.05

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	25,471.84	0.01
TOKI-RURI	2,592.62	0.01
TOKI-TRURI	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage[*2](%)
/home	1,735.69	1.19
/data	50,401.71	0.84
/ssd	1,144.41	0.60

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[*2](%)
J-SPACE	2.10	0.07

[*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.