Research on High Speed Propulsion Systems using Hydrogen Fuel

● Responsible Representative

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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.

http://www.aero.jaxa.jp/eng/research/frontier/hst/

● Reasons for using of JSS2

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

● Achievements of the Year

(1) Aerodynamics of the Hypersonic Cruise Experimental Aircraft was evaluated by CFD analyses. (Fig.1)

(2) Aerodynamics of the High Mach Integreted Control Experimental Aircraft was evaluated by CFD analyses. (Fig.2, Fig. 3)
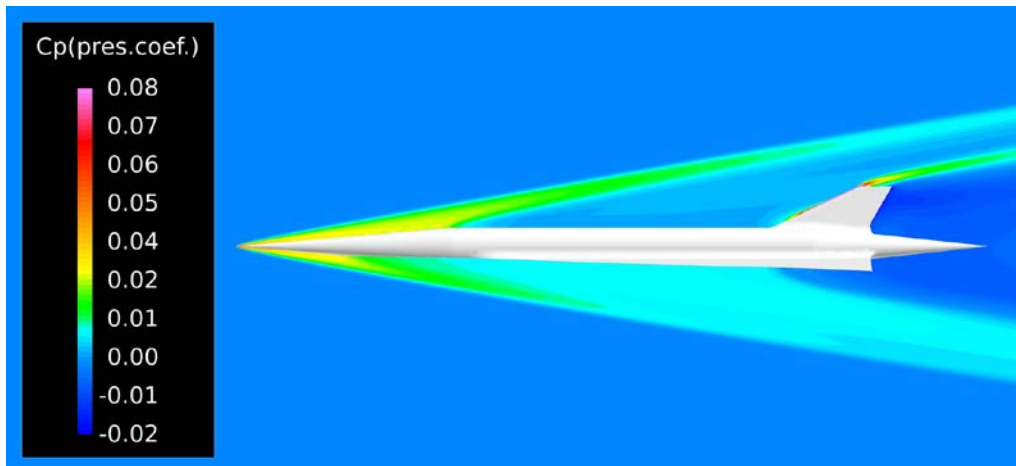
Fig.1 Hypersonic Cruise Experimental Aircraft （Cp Contour, Mach 7, AoA=0deg）
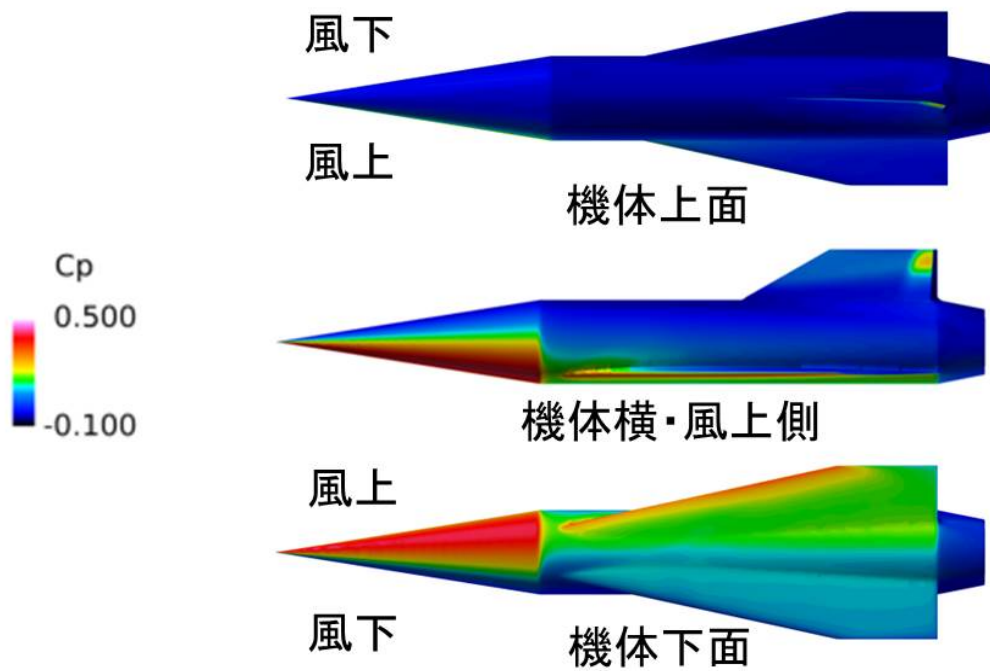

Fig.2 Hypersonic Control Experimental Aircraft (Cp Contour, Mach 5, AoA=15deg)
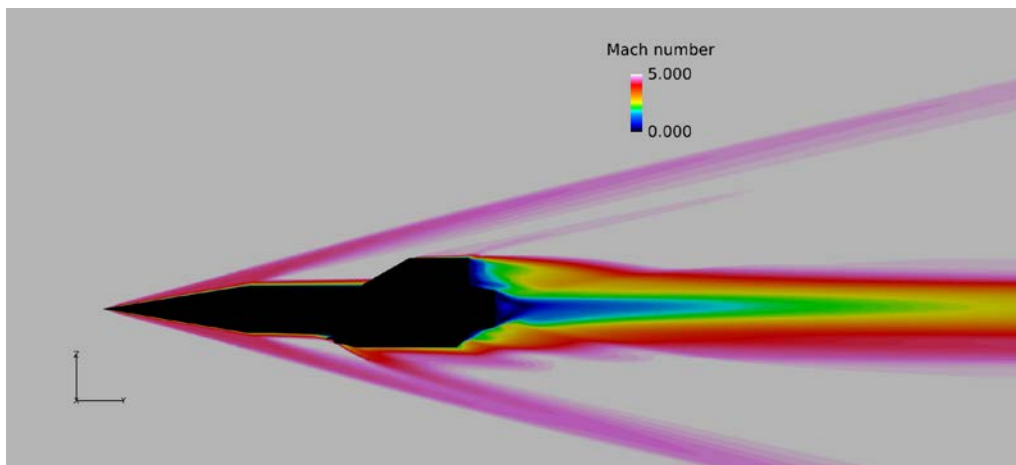

Fig.3 High Mach Integrated Control Experimental Aircraft (Mach Contour, Mach 5, AoA=0deg)

● Publications

- ■ Non peer-reviewed papers

1) Hiruma, M., Hirotani, T., Hongoh, M., Taguchi, T. and Tezuka, A., "Aerodynamic Evaluation of Hypersonic Cruise Experimental Aircraft," 61th Joint Conference on Space Science and Technology, 2017.

2) Butsuen, J., Hirotani, T., Taguchi, T., Hongoh, M., Tezuka, A. and Hiruma, M, "Lateral and Directional Aerodynamics Evaluation of High Mach Integrated Control Experimental Aircraft," 55th Aircraft Symposium, 2017.

● Presentations

1) Hiruma, M., Hirotani, T., Hongoh, M., Taguchi, T. and Tezuka, A., "Aerodynamic Evaluation of Hypersonic Cruise Experimental Aircraft," 61th Joint Conference on Space Science and Technology, 2017.

2) Butsuen, J., Hirotani, T., Taguchi, T., Hongoh, M., Tezuka, A. and Hiruma, M, "Lateral and Directional Aerodynamics Evaluation of High Mach Integrated Control Experimental Aircraft," 55th Aircraft Symposium, 2017.

● Usage of JSS2

● Computational Information

Parallelization Methods	MPI
Thread Parallelization Methods	OpenMP
Number of Processes	60 - 144
Elapsed Time per Case	72.00 hours

● Resources Used

Fraction of Usage in Total Resources*1 (%): 0.84

Details

Computing Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage*2 (%)
SORA-MA	6,527,843.25	0.87
SORA-PP	6,058.37	0.08
SORA-LM	6,584.94	3.39
SORA-TPP	0.00	0.00

File System Resources		
File System Name	Storage assigned(GiB)	Fraction of Usage*2 (%)
/home	2,145.77	1.49
/data	53,710.96	0.99
/ltmp	8,789.07	0.66

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