Hydrogen Application to Aircraft and Future Space Transportation System

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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

LES of combustion inside the model afterburner of pre-cooled turbojet engine with single injector. Two case of different injection hole diameter(1.0 mm and 1.4 mm) at equivalence ratio of 2.3 were conducted.

The aerodynamic characteristic of low-speed experimental aircraft with engine nacels on the main wings and with landing gears and a pulse detnation engine under the body was evaluaetd by CFD.

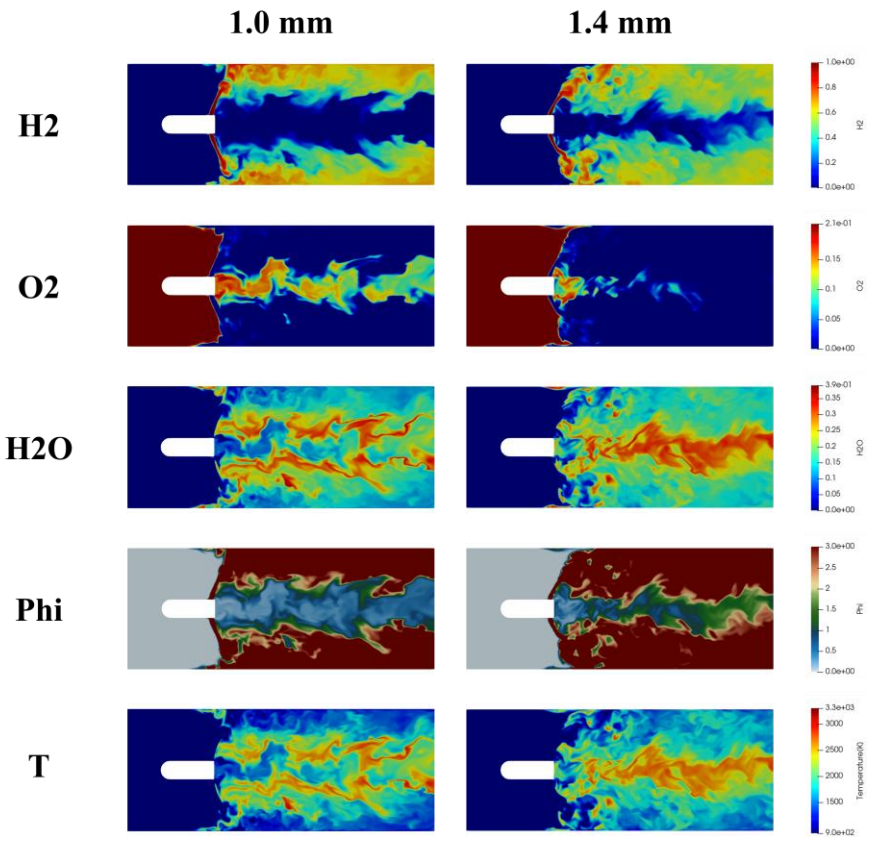

Fig. 1: moler fraction of H2,O2, H20, equivalence ratio and temperature distribution at the plane including 60 deg injection hole.

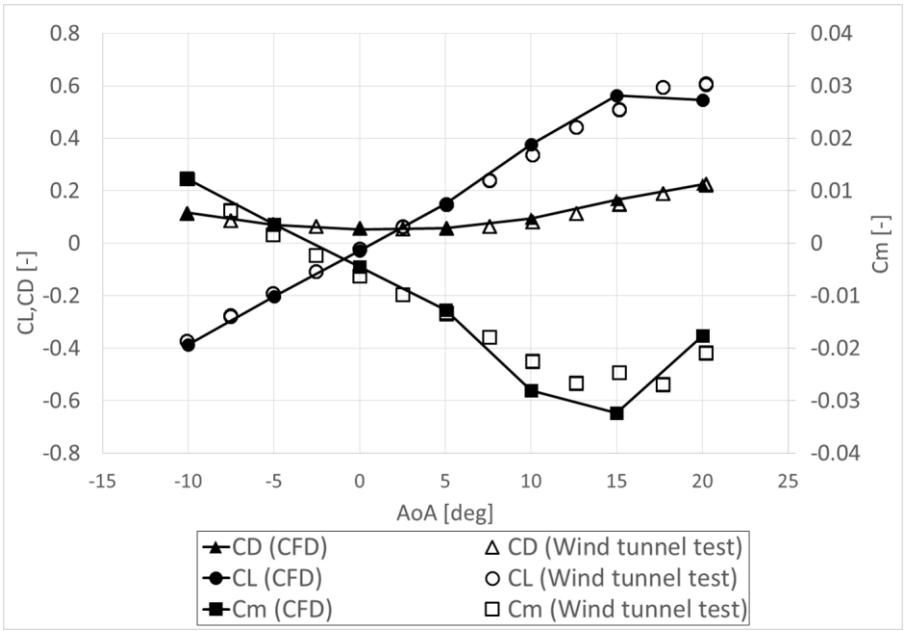

Fig. 2: Low-Speed Experimental Aircraft (Pressure Coefficient Contour, Mach 0.147, AoA: 0deg)

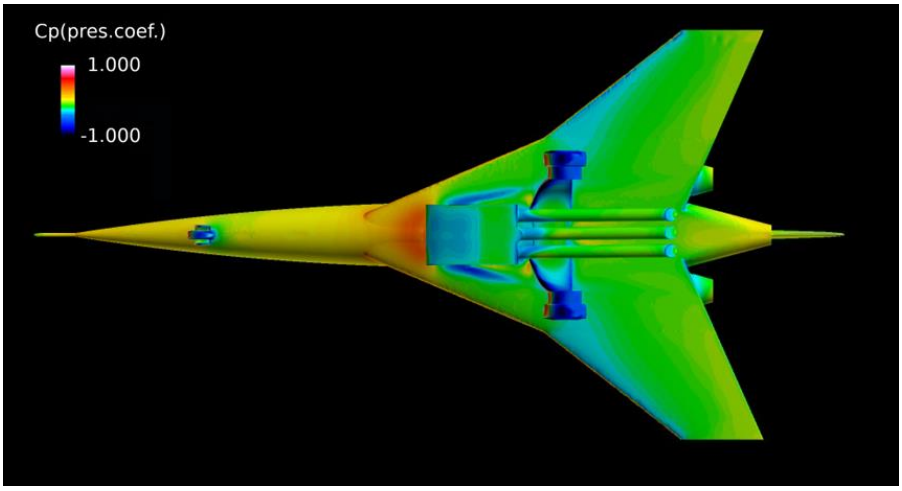

Fig. 3: Low-Speed Experimental Aircraft (Longitudinal Three Component Force Compared With Wind Tunnel Test, Mach 0.147)

Publications

- Non peer-reviewed papers

Mizuki Fukazawa, Tomonari Hirotani, Hideyuki Taguchi, Kazumasa Kamisori, Asei Tezuka, Evaluation of effect on model support method in a low speed wind tunnel test of double delta wing aircraft with engines, 59th Aircraft Symposium, 2021.

- Oral Presentations

Mizuki Fukazawa, Tomonari Hirotani, Hideyuki Taguchi, Kazumasa Kamisori, Asei Tezuka, Evaluation of effect on model support method in a low speed wind tunnel test of double delta wing aircraft with engines, 59th Aircraft Symposium, 2021.

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)

- **JSS3 Resources Used**

Fraction of Usage in Total Resources[*1](%): 1.03

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	21,710,483.50	1.06
TOKI-ST	654,819.28	0.81
TOKI-GP	6,590.92	4.38
TOKI-XM	0.00	0.00
TOKI-LM	650.20	0.05
TOKI-TST	0.00	0.00
TOKI-TGP	0.00	0.00
TOKI-TLM	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage[*2](%)
/home	2,868.33	2.85
/data and /data2	113,047.33	1.21
/ssd	6,503.33	1.68

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[*2](%)
J-SPACE	8.78	0.06

[*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.

- **ISV Software Licenses Used**

ISV Software Licenses Resources		
	ISV Software Licenses Used (Hours)	Fraction of Usage*2(%)
ISV Software Licenses (Total)	2,725.54	1.91

*2: Fraction of Usage：Percentage of usage relative to each resource used in one year.