Numerical Prediction of aerodynamic characteristics over the eVTOL Configurations

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Abstract

Various types of eVTOL (electric vertical take-off and landing aircraft) have been proposed to develop new mobility markets such as air taxis, and global competition is intensifying. However, the development history of eVTOL is relatively short, and there is little data for designing products that meet the various needs. Therefore, numerical simulations are expected to be used as a means of compensating data.

In this study, Unsteady Reynolds-averaged Navier-Stokes analysis was performed on the LA-8 geometry toward the evaluation of aerodynamic characteristics of a distributed electric propulsion vertical takeoff and landing aircraft.

Ref. URL: https://www.aero.jaxa.jp/eng/research/basic/numerical/

Reasons and benefits of using JAXA Supercomputer System

JSS is necessary to complete large scale numerical simulations of unsteady phenomena and to understand it in short time span.

Achievements of the Year

Unsteady Reynolds-averaged Navier-Stokes analysis was performed on the LA-8 geometry toward the evaluation of aerodynamic characteristics of a distributed electric propulsion vertical takeoff and landing aircraft (Figure 1 and 2) . The results show that the lift coefficients of LA-8 with propellers are larger than that of LA-8 without propellers. This is because the dynamic pressure coming into the wing was increased by the propeller slipstream (wake flow).

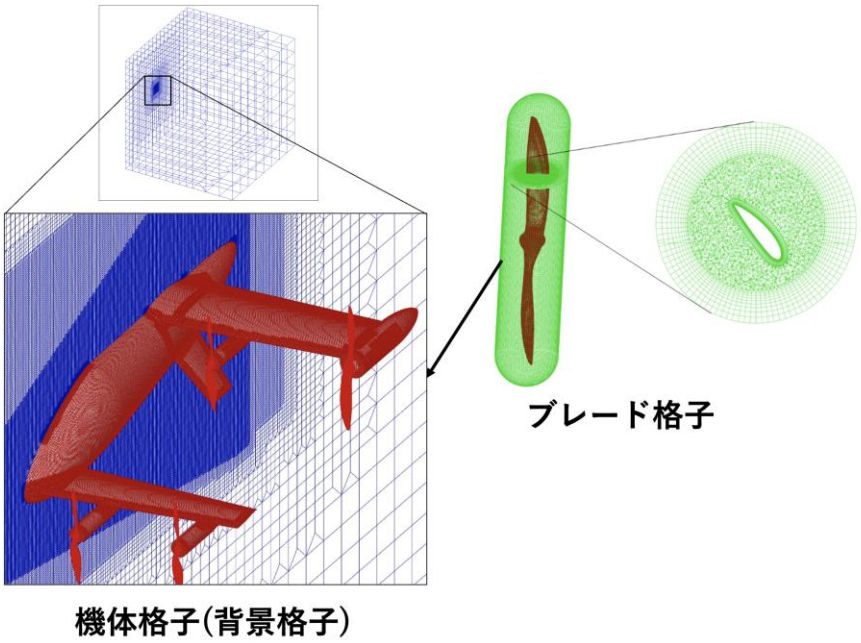

Fig. 1: Computational Grids.

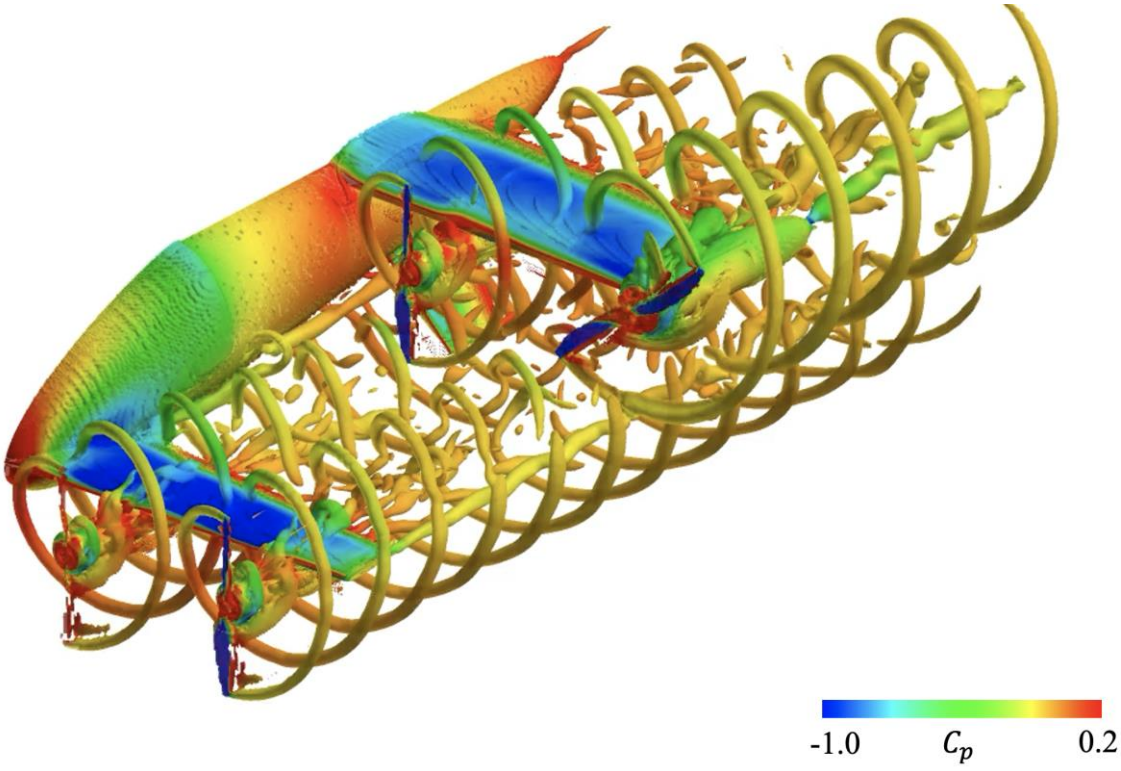

Fig. 2: Typical flowfield over LA-8 (Q-criterion).

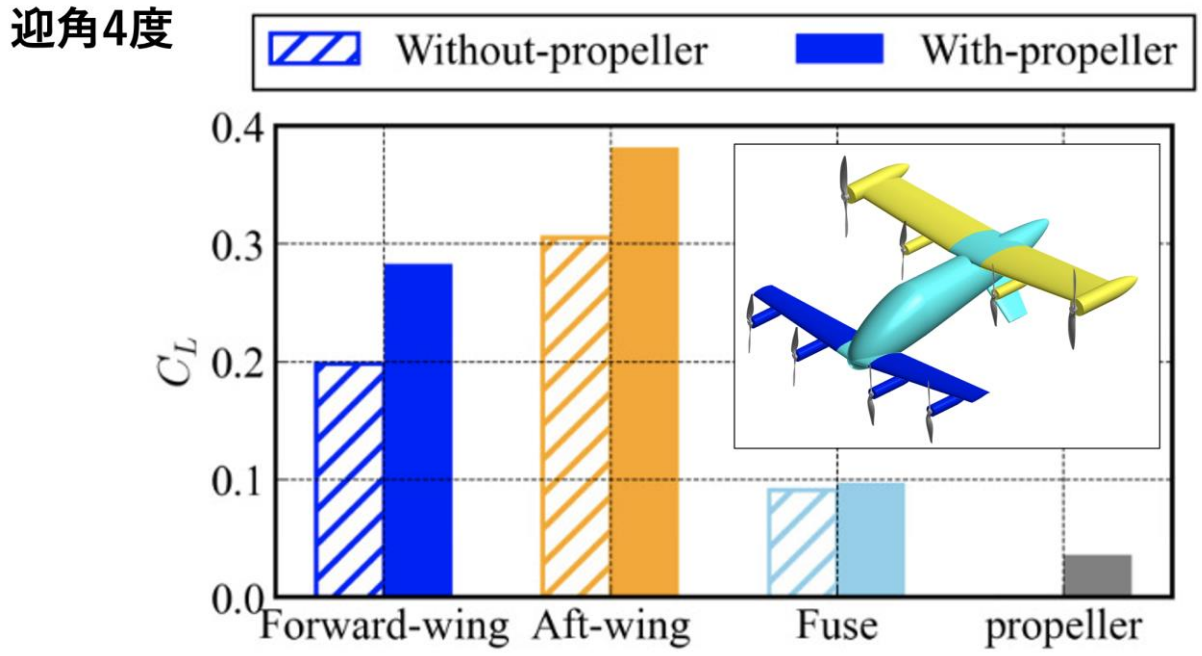

Fig. 3: The Effect of propeller on the lift coefficients.

Publications

- Oral Presentations

[1]S. Taniguchi, A. Shinozuka, K Yasue, M Kanayama , A. Oyama and A.i Hashimoto, "Numerical analysis toward the evaluation of aerodynamic characteristics of a distributed electric propulsion vertical takeoff and landing aircraft," 60th Aircraft Symposium, 2022.

[2]S. Taniguchi, K, Yasue, R. Fukuchi, A. Shinozuka, A. Oyama, "Aerodynamic Interference between Propeller/Wing for High Performance Electric Aircraft Using FaTAR-Move," Japan-Korea Joint Workshop on Rotorcraft, 2022.

Usage of JSS

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	N/A
Number of Processes	480 - 2016
Elapsed Time per Case	200 Hour(s)

- **JSS3 Resources Used**

Fraction of Usage in Total Resources[*1](%): 0.36

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	9,550,254.01	0.42
TOKI-ST	17,611.76	0.02
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	20,581.53	1.38
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	1,278.09	1.16
/data and /data2	118,524.76	0.91
/ssd	1,345.48	0.19

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[*2] (%)
J-SPACE	6.64	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.

- **ISV Software Licenses Used**

ISV Software Licenses Resources		
	ISV Software Licenses Used (Hours)	Fraction of Usage[*2] (%)
ISV Software Licenses (Total)	310.75	0.22

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