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 and modified LA-8 geometry (WT-01) 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

In this study, aerodynamic analysis of a tandem tilt-wing eVTOL (electric Vertical Take Off and Landing aircraft) was conducted using Unsteady Reynolds-Averaged Navier-Stokes (URANS) analysis, specifically targeting the transition flight phase. A 74% scale model of the NASA LA-8 aircraft, with tilt angles set at 22.5 degrees, 45.0 degrees, and 67.5 degrees, was analyzed (Fig, 1 and 2). It was found that the aerodynamic characteristics during continuous transition flight are qualitatively determined by the angle of attack of wings, regardless of the tilt angle (Fig, 3).

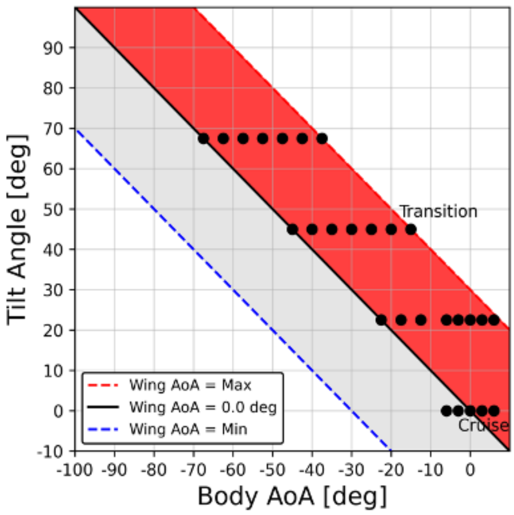

Fig. 1: Computational conditions for the transition flight phase

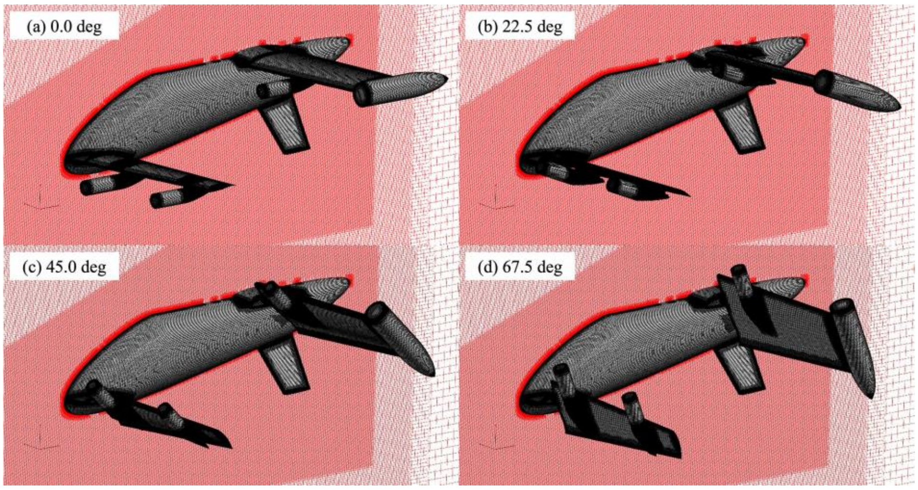

Fig. 2: Computational grids ((a) 0.0 deg, (b) 22.5 deg, (c) 45.0 deg, (d) 67.5 deg)..

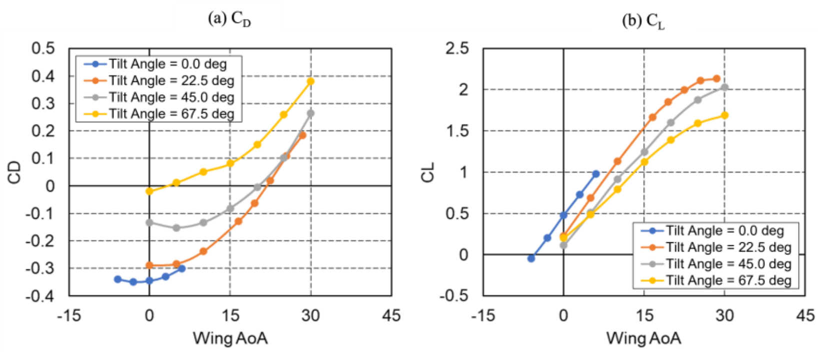

Fig. 3: Obtained aerodynamic coefficients.

- **Publications**

N/A

- **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](%): 0.17

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	4,164,282.54	0.19
TOKI-ST	4,842.60	0.00
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	319.18	0.02
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	1,428.28	0.96
/data and /data2	133,498.58	0.64
/ssd	2,510.00	0.13

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[*2] (%)
J-SPACE	7.01	0.02

[*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)	98.44	0.07

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