Analysis of aerodynamic interference between rotor and propeller

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Abstract

In Japan, the realization of electric vertical take-off and landing (eVTOL) aircraft are being researched and developed. The interaction between the rotor wake and the propulsion propeller creates a complex flow field that can affect both aerodynamic performance and noise on the eVTOL aircraft which consist of multiple rotor and propeller. This project investigates the aerodynamic performance and noise resulting from the aerodynamic interference between the rotor wake and the propulsion propeller.

Reasons and benefits of using JAXA Supercomputer System

To analyze the aerodynamic performance and noise of lift and cruise type eVTOLs using the CFD solver "rFlow3D" and acoustic analysis tool "rNoise" developed at JAXA.

Achievements of the Year

Investigation of aerodynamic interaction phoenomenon between a lift-rotor and a proplusive propeller through numerical simulations are performed. Lift and cruise aircraft is assumed in this study, and the computational model is simplified as a single lift-rotor and a single propeller. The aerodynamic interference between the rotor wake and the propulsion propeller is investigated by varying the propeller position and the advance ratio (Fig. 1). It is found that the torque and efficiency of the propulsion propeller change depending on the propeller position.

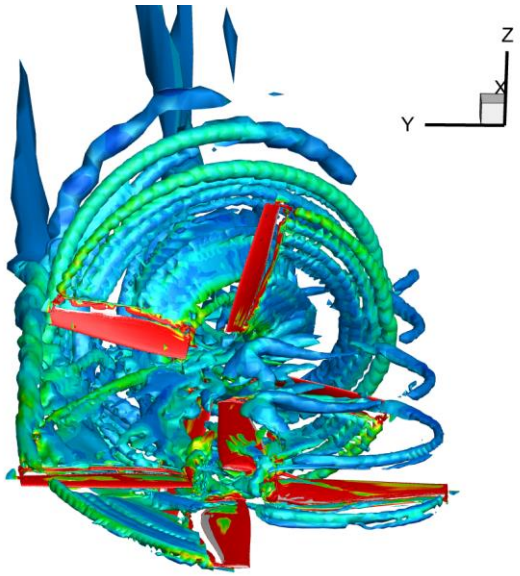

Fig. 1: Flow visualization around the rotor and propeller

- **Publications**

  N/A

- **Usage of JSS**

- **Computational Information**

Process Parallelization Methods	N/A
Thread Parallelization Methods	OpenMP
Number of Processes	1
Elapsed Time per Case	336 Hour(s)

- **JSS3 Resources Used**

Fraction of Usage in Total Resources[*1](%): 0.07

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	0.00	0.00
TOKI-ST	585,510.05	0.60
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	16,133.02	1.16
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	21.31	0.01
/data and /data2	134,351.30	0.64
/ssd	218.26	0.01

Archiver Resources		
Archiver 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.

- **ISV Software Licenses Used**

ISV Software Licenses Resources		
	ISV Software Licenses Used (Hours)	Fraction of Usage[*2] (%)
ISV Software Licenses (Total)	0.00	0.00

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