Numerical Simulation of Multirotor

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Abstract

Multirotor aircraft, such as drones and electric vertical take-off and landing (eVTOL) aircraft, generate complex flow fields due to interactions among multiple rotors. These flow fields interferes with various components of the aircraft, affecting aerodynamic performance and thrust fluctuations. This project focuses on the aerodynamic interference phenomena in multirotor aircraft and aims to develop methods for enhancing rotor performance and mitigating thrust fluctuations.

Reasons and benefits of using JAXA Supercomputer System

The aerodynamic analysis of a multirotor requires complex flow fields and vortices to be captured and large-scale analysis using a supercomputer.

Achievements of the Year

The aerodynamic analysis of a multirotor has been conducted using rFlow3D, a CFD analysis tool for rotorcraft. Multiple rotors were arranged, and the effects of rotor speed, rotational direction, and rotor layout on the aerodynamic performance of the multirotor were investigated (Fig.1). The analysis results indicate that by appropriately setting the rotor speed, rotational direction and rotor layout, it is possible to suppress the thrust fluctuations while mitigating the performance degradation caused by aerodynamic interference.

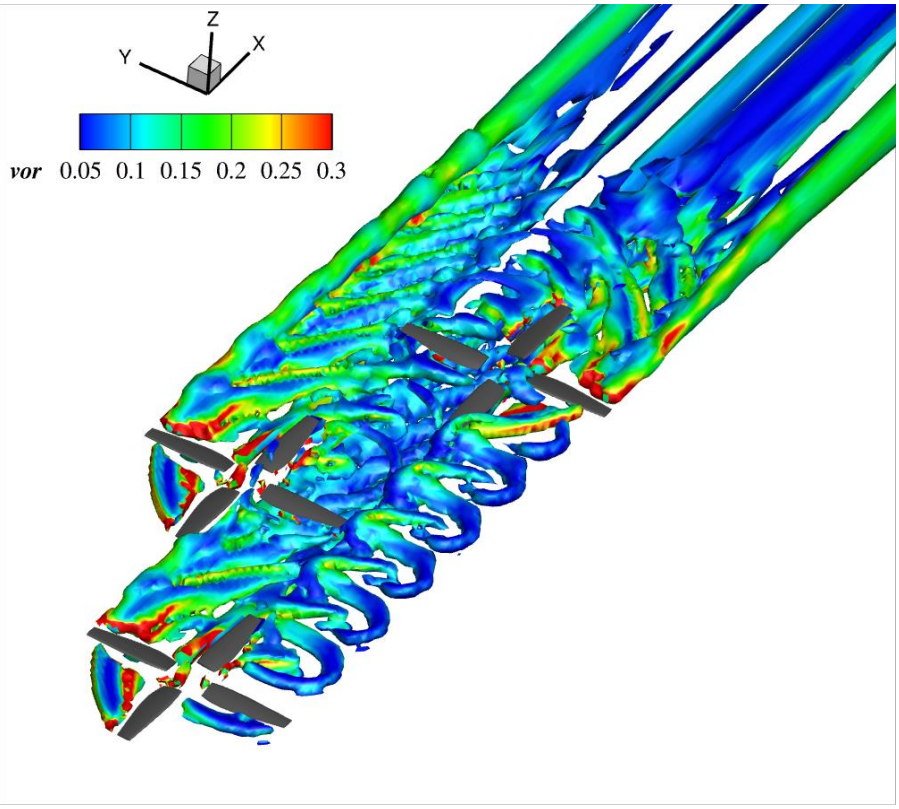

Fig. 1: Flow field of complex tip vortices around a multirotor.

- **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](%): 0.21

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	0.00	0.00
TOKI-ST	1,762,439.85	1.81
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	0.00	0.00
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	184.64	0.12
/data and /data2	129,708.88	0.62
/ssd	1,891.60	0.10

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)	36.59	0.02

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