

Aerodynamic analysis of multirotor

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● Abstract

The flowfield around the rotor is unsteady and highly complex due to the tip vortices from the rotor blades. Multirotor drones and eVTOL aircraft have complex flowfield interference between rotors. The aerodynamic interference changes the aerodynamic performance of the rotor. This study aims to investigate the effect of aerodynamic interference between rotors on the aerodynamic performance of the rotor.

● Reasons and benefits of using JAXA Supercomputer System

The numerical simulations of multirotor require large amount of memories and high computing capability.

● Achievements of the Year

Numerical simulations are conducted to investigate the aerodynamic interference phenomenon of the multirotor and the impact of aerodynamic interference on the aerodynamic performance of the rotor. The rotorcraft CFD tool, rFlow3D, developed at JAXA is utilized in this study. The computational model is based on a quadrotor drone, and a moving overlapped grid is applied to simulate the rotation of the rotor blade, as shown in Fig. 1. Figure 2 shows the tip vorticity flowfield around the quadrotor. Simulation results show that the aerodynamic interference caused by the complex tip vorticity flowfield occurs between the front and rear rotors and significantly impacts the aerodynamic performance of the rear rotor.

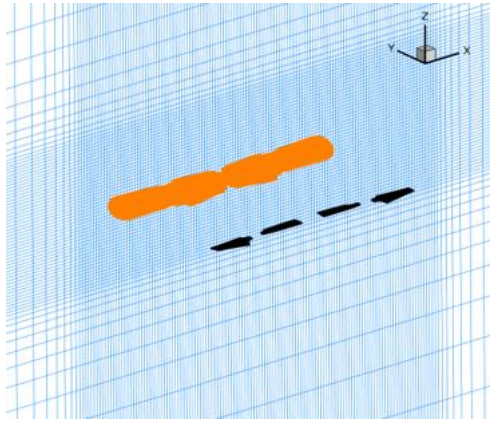


Fig. 1: Moving overlapped grid system

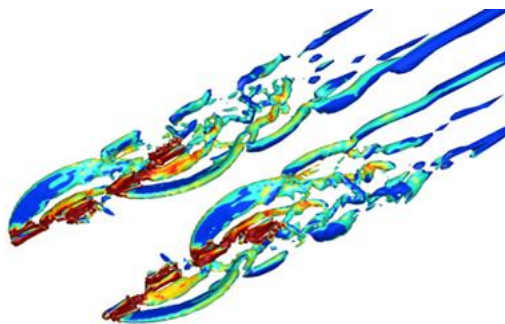


Fig. 2: Tip vorticity flowfield around the quadrotor

- **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	100 Hour(s)

● **JSS3 Resources Used**

Fraction of Usage in Total Resources*1(%): 0.24

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage*2(%)
TOKI-SORA	0.00	0.00
TOKI-ST	1,779,239.54	1.78
TOKI-GP	0.00	0.00
TOKI-XM	850.59	0.53
TOKI-LM	46,966.59	3.15
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	726.87	0.66
/data and /data2	146,271.04	1.13
/ssd	7,056.97	0.98

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)	810.18	0.56

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