

## Aerodynamics and Aeroacoustics Analysis for Multirotor

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### ● Abstract

This work focuses on a blade design for multirotors such as drones and electric vertical take-off and landing (eVTOL) aircraft. The numerical simulations are conducted to investigate the blade designs that achieve both aerodynamic performance and low aerodynamic noise. The effect of blade design parameters on aerodynamic performance and noise are investigated for a multicopter and a lift-and-cruise type aircraft.

### ● Reasons and benefits of using JAXA Supercomputer System

Large-scale analysis using a supercomputer is required to simulate a multirotor.

### ● Achievements of the Year

The aerodynamic performance and noise of the multirotor are evaluated using the rotorcraft CFD tool, rFlow3D, and the rotorcraft noise analysis tool, rNoise. The multirotor constructed for the coaxial rotor system is assumed. Numerical simulations are performed under hovering and forward flight conditions. Numerical results show higher noise levels than single-rotor systems due to rapid pressure fluctuations when crossing upper and lower rotor blades. Furthermore, the tip vortices of the forward rotor interact with the rear rotor, affecting aerodynamic performance and noise.

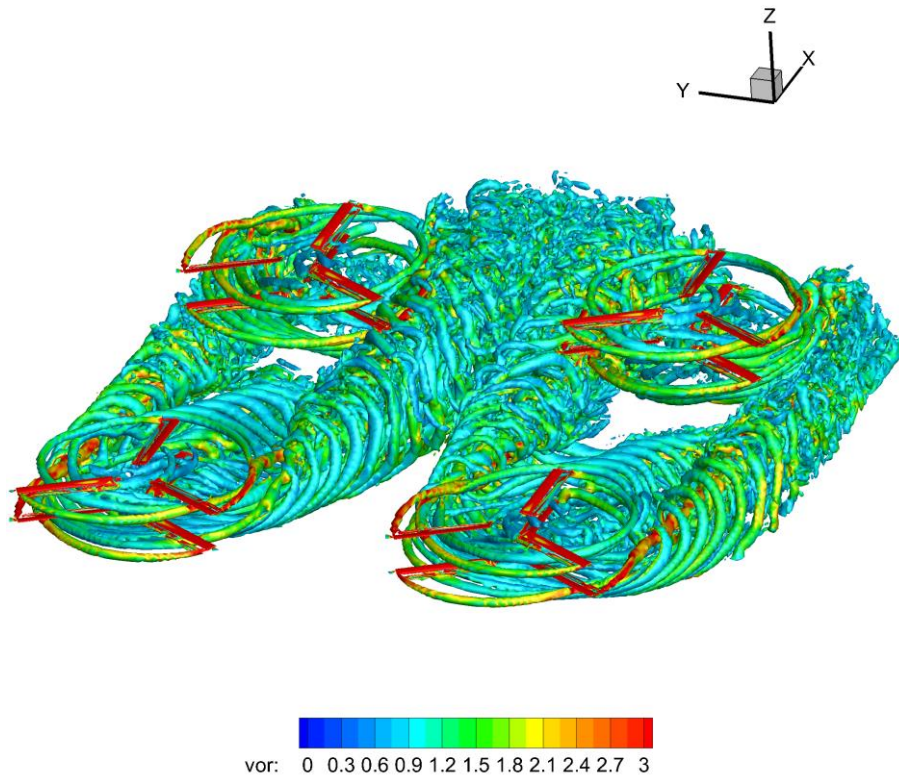


Fig. 1: Flowfield around the multirotor.

● **Publications**

- Peer-reviewed papers

Furukawa, et. al, "Rotor Design of an Urban Air Mobility for Compromising Aerodynamic Performance and Noise," Journal of the Japan Society for Aeronautical and Space Sciences

- Non peer-reviewed papers

Furukawa, et. al, "Rotor Design Compromising Aerodynamic Performance and Noise", The 55th Fluid Dynamics Conference/The 41st Aerospace Numerical Simulation Symposium

● **Usage of JSS**

● **Computational Information**

Process Parallelization Methods	N/A
Thread Parallelization Methods	OpenMP
Number of Processes	1
Elapsed Time per Case	504 Hour(s)

● **JSS3 Resources Used**

Fraction of Usage in Total Resources\*1(%): 0.13

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage*2(%)
TOKI-SORA	0.00	0.00
TOKI-ST	1,037,924.75	1.12
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	81.00	0.01
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	1,162.93	0.97
/data and /data2	175,071.47	1.08
/ssd	5,220.80	0.49

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 <sup>*2</sup> (%)
ISV Software Licenses (Total)	39.34	0.02

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