Aanalysis of Rotorcraft Aerodynamics through Computational Fluid Dynamics

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Abstract

The tiltrotor configurations have been adopted as one of the aircraft configurations for urban air mobility. The rotor of the tiltrotor type aircraft, known as prop rotor, acts similarly to a helicopter rotor in hover and operates to generate propulsion as a propeller in forward flight. The prop rotor is required to have the hover performance as a rotor and the propulsive efficiency as a propeller at the same time. The two flight conditions and the aerodynamic environment around the rotor are significantly different. The aerodynamics of the prop rotor is investigated using an in-house code based on panel method developed at Nagoya University and rFlow3D, a CFD code for rotorcraft developed at JAXA.

Reasons and benefits of using JAXA Supercomputer System

A large number of computational resources is required to simulate many analysis cases.

Achievements of the Year

The aerodynamic performances of the rotor in hover and forward flight are investigated, assuming rotor specifications for urban air mobility through numerical simulations. The rotor performance is validated by the panel method (Fig. 1) and CFD analysis (Fig. 2). Both results showed generally reasonable agreement. Numerical simulations show that the pitch angle of the blade root is important as the design parameter to achieve high efficiency in both hover and forward flight performance.

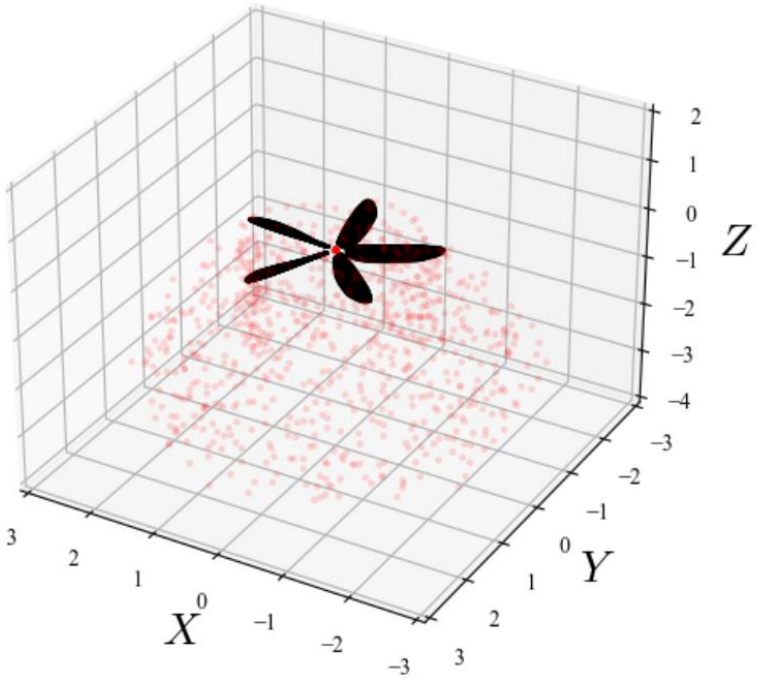

Fig. 1: Tip vortex distribution visualized by Q-criterion (rFlow3D)

Fig. 2: Tip vortex distribution (panel method)

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	240 Hour(s)

JSS3 Resources Used

Fraction of Usage in Total Resources[*1](%): 0.05

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	38,784.65	0.00
TOKI-ST	364,902.51	0.45
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	0.00	0.00
TOKI-TST	864.02	0.02
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	539.18	0.54
/data and /data2	33,814.51	0.36
/ssd	5,520.99	1.43

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.