Study of forward flight performance of multiple rotors

Report Number: R20ETET07
Subject Category: Skills Acquisition System
URL: https://www.jss.jaxa.jp/en/ar/e2020/14399/

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Abstract

Study of forward flight performance of multi-rotor aircraft

Reasons and benefits of using JAXA Supercomputer System

In order to perform a rotorcraft analysis tool.

Achievements of the Year

Numerical analyses are performed on a rotor of a multi-rotor aircraft using rotorcraft CFD tool. The rotor is set horizontally, assuming a configuration in which the aircraft is equipped with a propeller for propulsion and flies forward in a horizontal position (Fig. 1). These numerical analyses are conducted to investigate the improvement of forward flight performance of a rotor whose control parameters are not only rotational speed but also blade pitch angle. The results show that the forward flight performance can be improved while keeping the lift constant by controlling the rotational speed and the blade pitch angle simultaneously, compared to rotational speed control only (blade pitch angle fixed at 9.0 deg.) (Fig. 2).

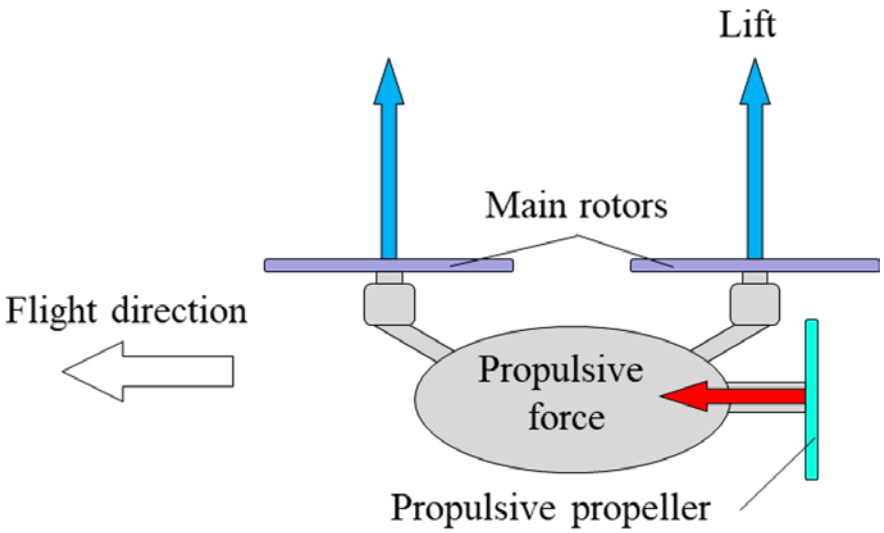

Fig. 1: Multi-rotor aircraft equipped with a propeller for propulsion and flying forward in a horizontal attitude.

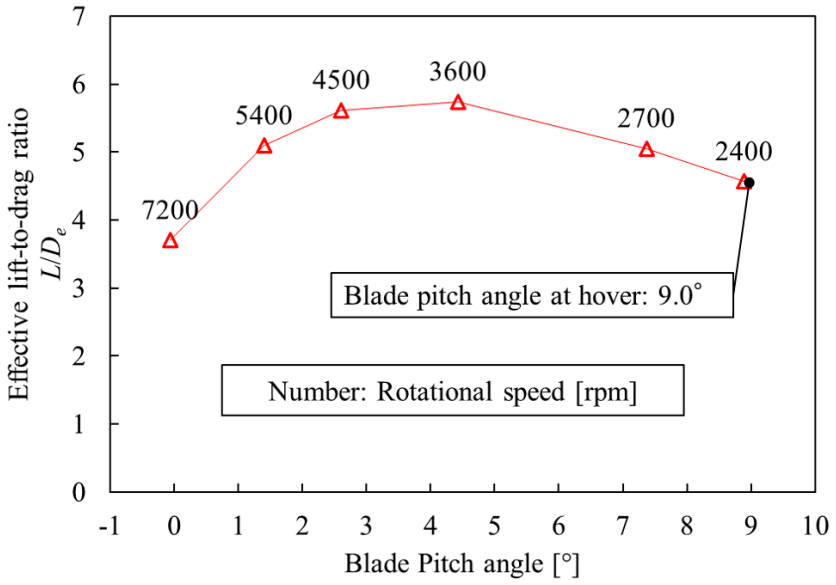

Fig. 2: Effective lift-to-drag ratio of a rotor with simultaneous control of rotational speed and blade pitch angle. Effective lift-to-drag ratio is a index of the forward flight performance of a rotor.

Publications

- Non peer-reviewed papers

Sayama, Y., Sugawara, H., Hayami, K., Tanabe, Y., Yonezawa, K., and Kameda, M., "Aerodynamic Characteristics of Variable Pitch Propeller for Horizontal Forward Flight Multicopter", 58th Aircraft Symposium, (2020).

- Oral Presentations

Sayama, Y., Sugawara, H., Hayami, K., Tanabe, Y., Yonezawa, K., and Kameda, M., "Aerodynamic Characteristics of Variable Pitch Propeller for Horizontal Forward Flight Multicopter", 58th Aircraft Symposium, (2020).

Usage of JSS

Computational Information

Process Parallelization Methods	N/A
Thread Parallelization Methods	OpenMP
Number of Processes	1
Elapsed Time per Case	50 Hour(s)

Resources Used(JSS2)

Fraction of Usage in Total Resources[*1](%): 0.06

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage[*2](%)
SORA-MA	0.00	0.00
SORA-PP	19,612.98	0.15
SORA-LM	0.00	0.00
SORA-TPP	24,857.99	2.35

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage[*2](%)
/home	759.34	0.70
/data	17,175.22	0.33
/ltmp	3,257.49	0.28

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.

- **Resources Used(JSS3)**

Fraction of Usage in Total Resources*1(%): 0.03

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage*2(%)
TOKI-SORA	0.00	0.00
TOKI-RURI	7,159.83	0.04
TOKI-TRURI	441.42	0.04

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage*2(%)
/home	759.34	0.52
/data	37,594.26	0.63
/ssd	594.28	0.31

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.