Aerodynamic Analysis for High-speed Rotorcraft

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Abstract

High-speed rotorcrafts operate at higher speeds than conventional helicopters and thus require more aerodynamically advanced design. This study investigates lift offset technology and hub drag reduction technology to achieve high aerodynamic performance.

Reasons and benefits of using JAXA Supercomputer System

Computational resources and computational capability are required to perform many numerical simulations.

Achievements of the Year

Lift offset technology utilizing differential flaps is investigated based on wind tunnel tests through numerical simulations (Figs. 1). The numerical results show a good correlation with the wind tunnel test results. It is indicated that the lift offset improves the system aerodynamic performance through the test and simulation. Numerical simulations are also conducted to investigate the flowfield around the rotor hub (Fig. 2). An effective drag reduction device is developed, and numerical results show that a significant drag reduction can be achieved.

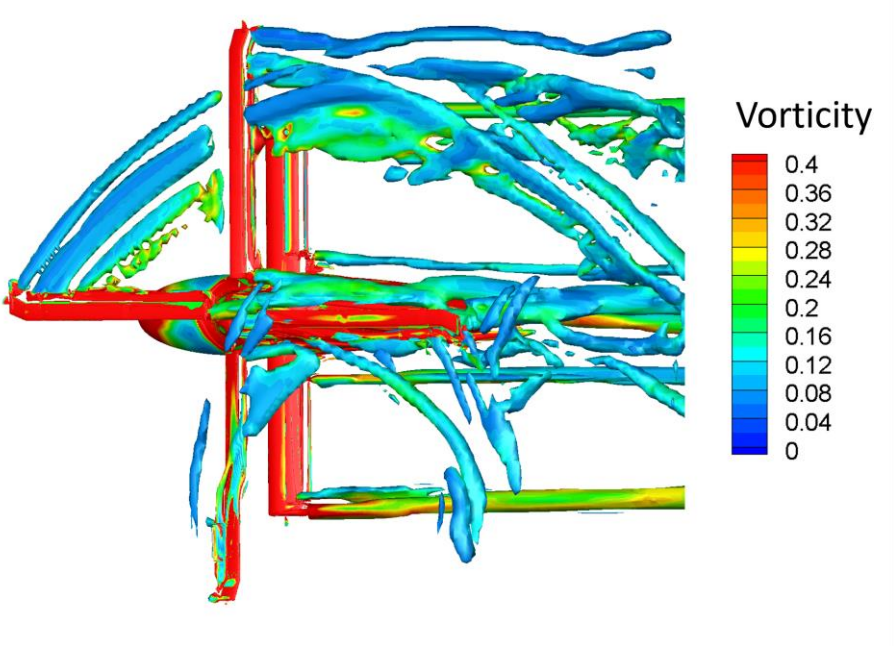

Fig. 1: Tip vortices around the rotorcraft

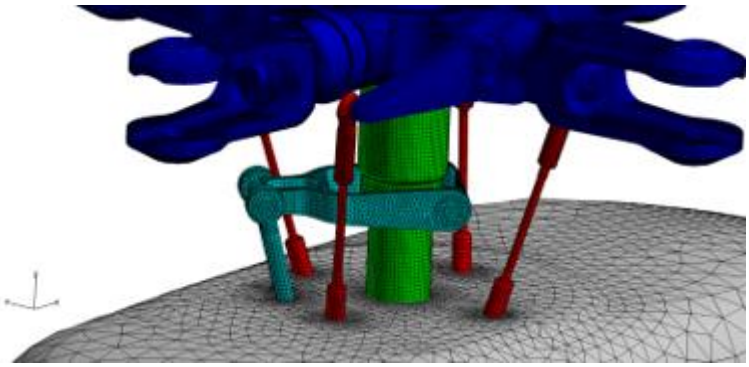

Fig. 2: Complex geometry and surface grid around hub

Publications

- Oral Presentations

Sugawara, H., Kobiki, N., Tanabe, Y., Sasaki, M., Higo, A., Nakamyra, M., "Wind Tunnel Test of Single-Rotor Lift-Offset Due to Differential Flaps,", 48th European Rotorcraft Forum, 2022.

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](%): 0.69

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	9,483,285.87	0.41
TOKI-ST	2,672,436.88	2.67
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	0.00	0.00
TOKI-TST	76,393.75	2.01
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	163.20	0.15
/data and /data2	120,434.73	0.93
/ssd	666.46	0.09

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[*2] (%)
J-SPACE	2.02	0.01

[*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.