High-spped rotorcrafts technology trainning

Report Number: R19ETET04
Subject Category: Skills Acquisition System
URL: https://www.jss.jaxa.jp/en/ar/e2019/11631/

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Abstract

Study for the aerodynamic characteristics of coaxial rotors.

Reasons and benefits of using JAXA Supercomputer System

In order to perform a rotorcraft analysis tool.

Achievements of the Year

Numerical analyses are performed using a rotorcraft CFD tool to research a coaxial rotor which is a part of the next generation rotorcraft. The numerical results suggest two remarks.

[1]The applying of a transition model is valid for the rotorcraft CFD analysis. The improvement of numerical accuracy on the blade surface is attributed by the transition model (Fig. 1).

[2]Lift offset, which is a flight parameter of the coaxial rotor, can control the magnitude of vibratory thrust fluctuation generated on the rotor (Fig. 2). The adjustment of optimal lift offset in responce to flight condition realize the reduction of thrust fluctuation.

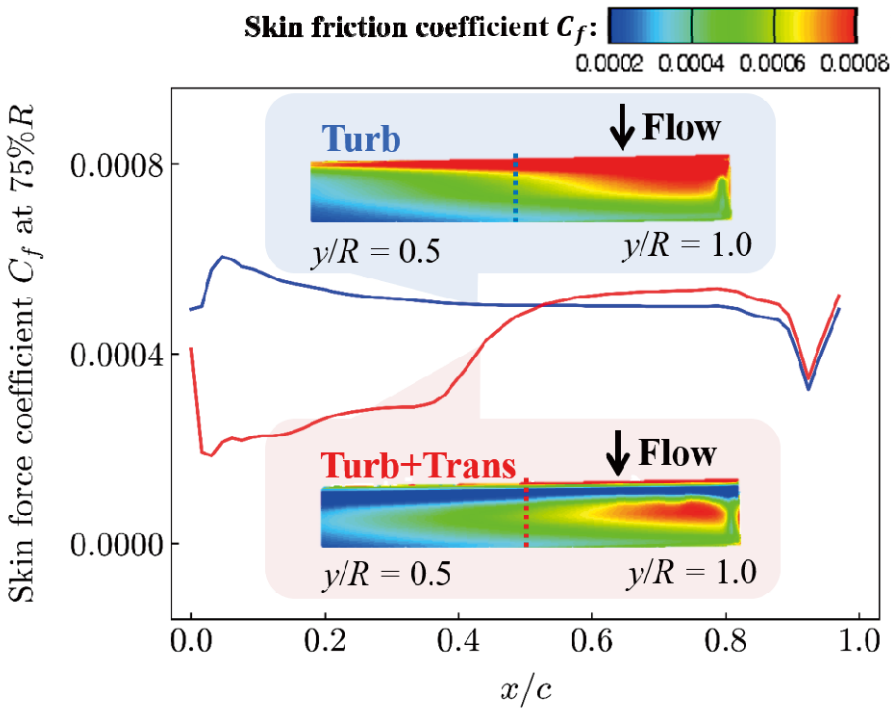

Fig. 1: The distribution of skin fricition on the blade upper surface at 75% radius chord-cross section. The blue line shows the results obtained by turbulence model (not considering transition), and the red line shows the results obtained by the turbulence+transition model. There is an obious difference between the two results, especially at 0-50% chord. The applying of transition model improves the numerical accuracy of skin friction.

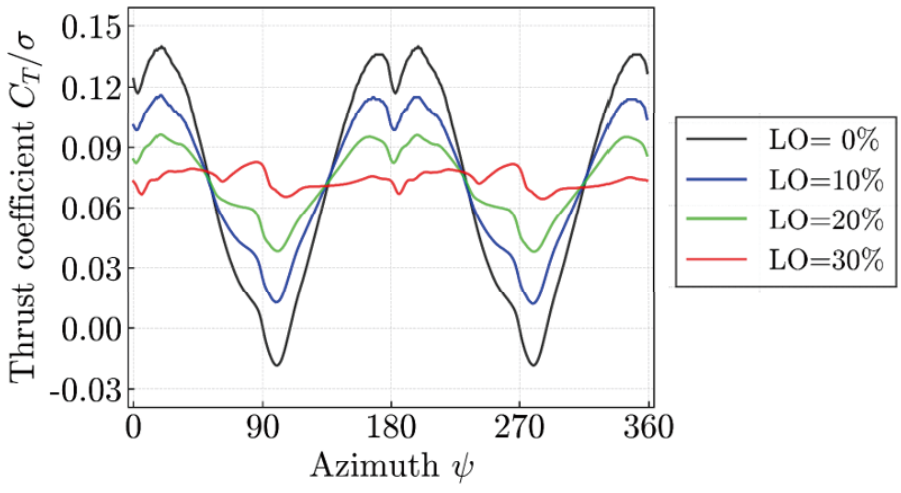

Fig. 2: The variation of thrust coefficient against the blade azimuth. Thrust fluctuates cyclically in response to the chages of blade azimuth. The fluctuation is also affected by lift offset (LO), and the amlitude of the flucutation is reduced.

Publications

- Oral Presentations

[1]Hayami, K., Sugawara, H., Tanabe, Y., and Kameda, M. , "Numerical Simulation of the Aerodynamic Characteristics of Coaxial Rotors", The Japan Society for Aeronautical and Space Sciences 50th annual meeting, (2019).

[2]Hayami, K., Sugawara, H., Tanabe, Y., and Kameda, M. "Investigation of Aerodynamic Interaction of a Lift Offset Coaxial Rotor by Numerical Simulation.", 8th Asian/Australian Rotorcraft Forum, (2019).

[3]Hayami, K., Sugawara, H., Tanabe, Y., and Kameda, M. "Numerical Investigation of Aerodynamic Interference on Coaxial Rotor", AIAA SciTech, (2020).

Usage of JSS2

Computational Information

Process Parallelization Methods	N/A
Thread Parallelization Methods	OpenMP
Number of Processes	1
Elapsed Time per Case	10 Hour(s)

Resources Used

Fraction of Usage in Total Resources[*1](%): 0.32

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage[*2](%)
SORA-MA	173,552.07	0.02
SORA-PP	562,500.28	3.64
SORA-LM	1.60	0.00
SORA-TPP	129,876.64	7.84

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage*2(%)
/home	287.40	0.24
/data	12,428.98	0.21
/ltmp	2,308.24	0.20

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.