Study of the Effect of Boundary Layer Ingestion (BLI) on Aircraft Propulsion

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Abstract

In this study, evaluation of unsteady aerodynamics in aircraft fan under strongly distorted inflow condition simulating airframe/engine integration configuration with Boundary Layer Ingestion (BLI) benefit suited for future electric aircraft. Under these BLI conditions, aircraft fan suffers almost all the flight path strongly distorted inflow conditions, the present study investigates the fan flows in detail through the numerical simulations.

Reasons and benefits of using JAXA Supercomputer System

The srudy deals with fan aerodynamic flows under inlet conditions of asymmetric distorsion inflow. For the purpose, high-resolution and full-annula duct flow analysis is necessary with the use of JSS2 supercomputer.

Achievements of the Year

Fan rotor unsteady aerodynamic flow analysis was conducted under the inflow distortion condition simulating airframe/engine integration configuration suited for future electric aircraft. Figure 1 shows entropy distribution at 96% span under non-distorted condition (upper side) and BLI condition (lower side). The figure indicates entropy increases remarkably in distorted region. Figure 2 comperes flow velocity under these two conditions and a reversed flow region was observed at tip side under BLI condition (lower side).

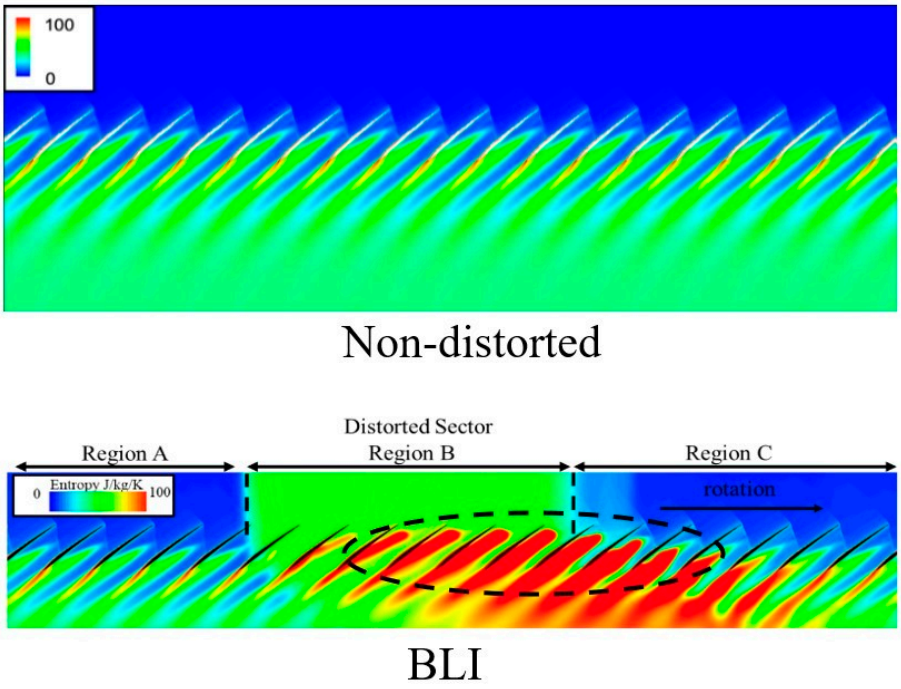

Fig. 1: Figure 1 Entropy distribution at 96% span

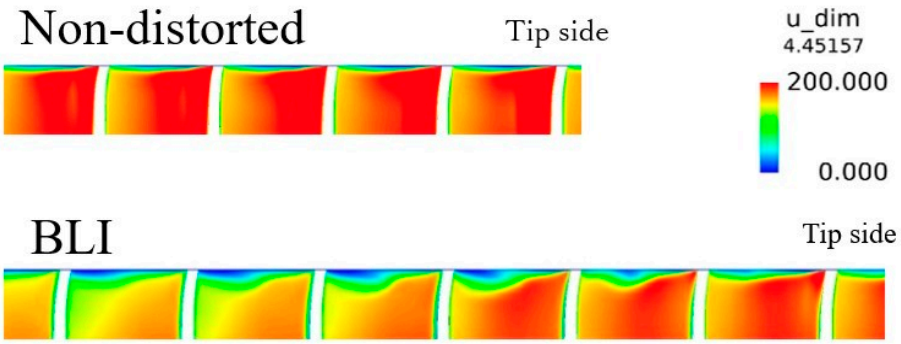

Fig. 2: Figure 2 Velocity distribution at tip side

Publications

- Oral Presentations

Masaki, A., Ogushi, S., Tsuruta, R., Nishiwaki, D., Sato, T., Okai, K., Kazawa, J., Masaki, D., Harada, M., Assessment of the Influence of Boundary Layer Ingestion (BLI) on the Axial Fan, ISROMAC2019-00113, 18th International Symposium on Transport Phenomena and Dynamics of Rotating Machinery (ISROMAC18), Virtual meeting, November 25th 2020.

Usage of JSS

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	OpenMP
Number of Processes	35 - 630
Elapsed Time per Case	10 Hour(s)

Resources Used(JSS2)

Fraction of Usage in Total Resources[*1](%): 1.91

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage[*2](%)
SORA-MA	11,173,884.39	2.11
SORA-PP	42,333.91	0.33
SORA-LM	2.81	0.00
SORA-TPP	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage[*2](%)
/home	958.90	0.88
/data	19,583.48	0.38
/ltmp	4,975.82	0.42

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](%): 0.01

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	3.79	0.00
TOKI-RURI	1,039.74	0.01
TOKI-TRURI	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage[*2](%)
/home	482.17	0.33
/data	9,818.92	0.16
/ssd	148.66	0.08

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.