Study of the Effect of Boundary Layer Ingestion (BLI) on Aircraft Propulsion / Distributed Propulsion Technology with Superconducting Motors

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Abstract

In this study, we evaluate the unsteady aerodynamics of an aircraft propulsion fan under strongly distorted inflow conditions simulating an airframe/engine integration configuration with Boundary Layer Ingestion (BLI) benefits suited for future electric aircraft. Under these BLI conditions, aircraft fan suffers strongly distorted inflow conditions, thereby the present study investigates the fan flows in detail through the numerical simulations.

Reasons and benefits of using JAXA Supercomputer System

The fan performance analysis under asymmetric distortion conditions requires unsteady full-annulus calculations, which increases the computational scale.

Achievements of the Year

The effect of forward swept rotor blades on the flow field was investigated under inlet conditions that simulate the inlet distortion of a fan embedded in the fuselage, which is assumed in electric aircraft. As a result, as shown in Fig. 1, the stall margin is significantly improved by the sweep geometry. The dimensionless vorticity at 99% span shown in Fig. 2 indicates that the sweep suppresses the development of blade tip leakage vortices.

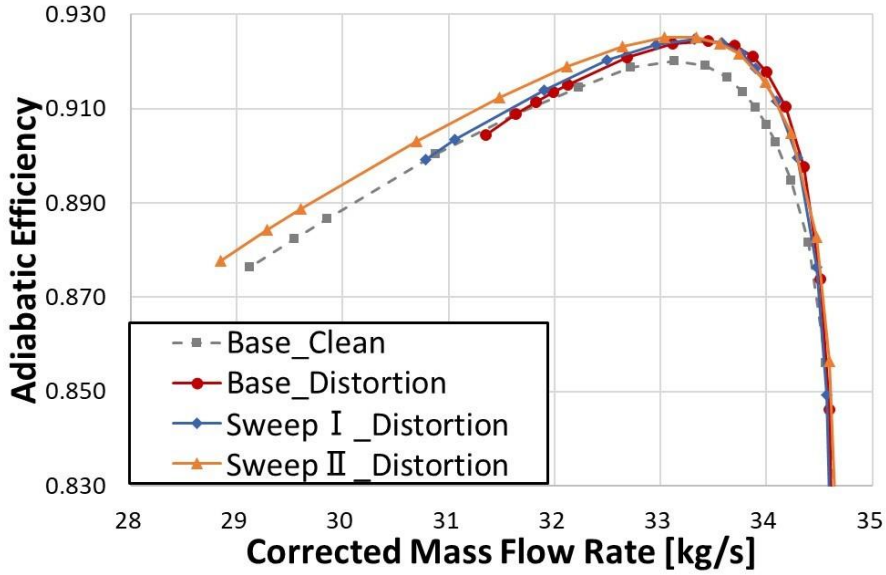

Fig. 1: Corrected Mass Flow - Adiabatic Efficiency

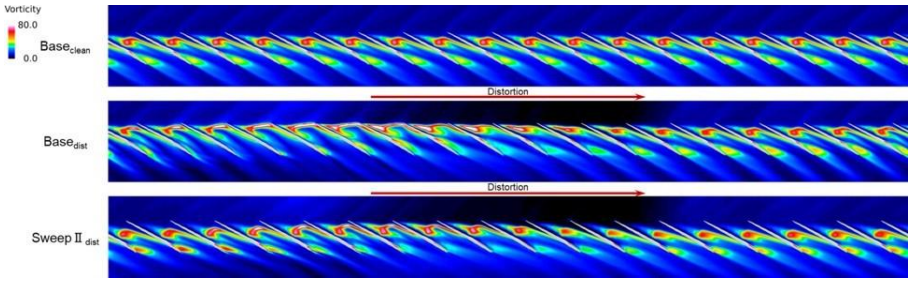

Fig. 2: Dimensionless Vorticity at 99% Span

- **Publications**

  N/A

- **Usage of JSS**

- **Computational Information**

Process Parallelization Methods	MPI
Thread Parallelization Methods	N/A
Number of Processes	81 - 120
Elapsed Time per Case	24 Hour(s)

- **JSS3 Resources Used**

Fraction of Usage in Total Resources[*1](%): 0.66

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	15,251,982.83	0.69
TOKI-ST	31,225.33	0.03
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	209,232.05	15.94
TOKI-TST	432.02	0.01
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	1,697.46	1.41
/data and /data2	208,277.69	1.28
/ssd	193.08	0.02

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)	5,481.06	2.47

[*2]: Fraction of Usage：Percentage of usage relative to each resource used in one year.