Research on High Performance Control Surfaces and High Lift Devices

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Abstract

The purpose of the research is to develop and mature a bunch of elemental technologies on aerodynamics, aeroacoustics, structures and sensing and system design technologies to achieve high perfromance control surfaces and high-lift devices with higher environmental performances of future aircraft application, thereby helping the Japanese aviation industry to enhance its share on the global market.

Reasons and benefits of using JAXA Supercomputer System

To develop and mature advanced elemental technologies of aerodynamics, aircraft noise reduction, and structures for future aircrafts, development of CFD technologies and CFD-based design/analyis have been conducted in this research. The high-fidelity CFD analysis of high performance control surfaces and high lift devices requires large computational resources. JSS enables the high-fidelity evaluations of the peformance in a timely manner and the technology developments.

Achievements of the Year

Drag reduction by the Natural-Laminar-Flow (NLF) wing is expected as one of key technologies to largely reduce fuel consumption and CO2 emissions. To achieve the practical use of the NLF wing, performance degradation by steps/discontinuities on wing surface and leading-edge contamination with insect debris to induce laminar-to-turbulent flow transition should be decreased. Conventional slats as leading-edge high-lift devices which are deployed to delay stall during take-off and landing have steps/discontinuities at the trailing-edge between upper surface of the main wing when retracted. As the alternative to the slats, Krueger flap system deployed from lower surface of the man wing is taken into consideration, with other advantages such as shielding effect for the leading-edge contamination against insect debris. In this research, improvements on the structures and kinematics of the Krueger flap have been investigated and the noise performances have been evaluated.

The design of the Krueger flap has been conducted for a representative NLF airfoil extracted from the outer wing of JAXA Technology-Reference-Aircraft 2022 (120-seat class). To improve the feasibility, the structure and kinematics of the Krueger flap have been simplified. The low-noise performances of the designed Krueger flap have been evaluated by comparing with the results of a conventional slat using unsteady CFD analyses (Fig.1).

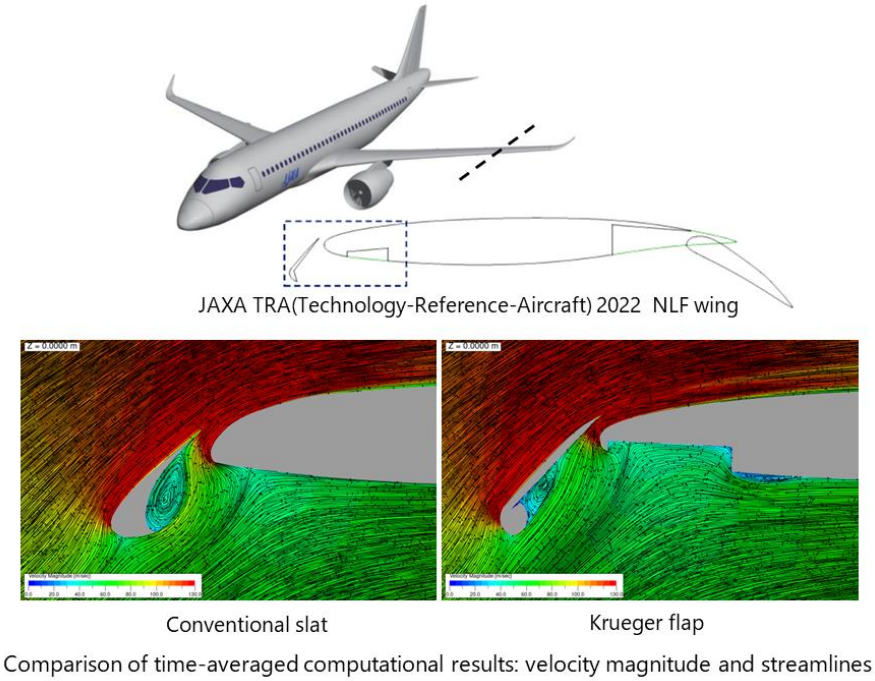

Fig. 1: Aerodynamic noise evaluation of the Krueger flap

- **Publications**

  N/A

- **Usage of JSS**

- **Computational Information**

Process Parallelization Methods	MPI
Thread Parallelization Methods	N/A
Number of Processes	192 - 256
Elapsed Time per Case	15 Hour(s)

- **JSS3 Resources Used**

Fraction of Usage in Total Resources[*1](%): 0.02

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	0.00	0.00
TOKI-ST	165,148.20	0.18
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	0.00	0.00
TOKI-TST	0.00	0.00
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	129.35	0.11
/data and /data2	3,881.18	0.02
/ssd	1,131.96	0.11

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[*2] (%)
J-SPACE	2.55	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)	2.65	0.00

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