Efficiency improvement of aerodynamic model building and comparison.

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Abstract

The air flow rate in the engine nacelle is adjusted using annular plugs placed in the nacelle to evaluate the effect of the air flow rate in the engine nacelle on the aerodynamic characteristics of the aircraft.

Reasons and benefits of using JAXA Supercomputer System

It is necessary to perform CFD computation including flow around a whole aircraft because it requires highly parallelized computation. Additionally, the JSS3 was chosen because the FaSTAR CFD solver is optimized, as well.

Achievements of the Year

Spillage drag varies with capture area ratio (CAR), but it is difficult to investigate it experimentally since the shape inside a flow-through nacelle of a testing model needs to be changed. To clarify the change in the spillage drag for the flow-through nacelle of a business jet geometry testing model, numerical analyses using computational grids of annular plugs inside the flow-through nacelle were performed. As a result, the differences in both the CAR and the axial component of the aerodynamic coefficient were observed by adding the plug. It was shown that a significant change in CAR is not apparent unless the plug is squeezed significantly, but too large a squeeze can cause flow separation inside the nacelle and adversely affect the aerodynamic coefficient.

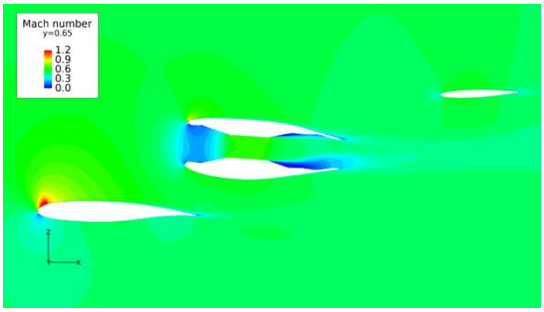

Fig. 1: Mach number distribution around the wing, inside the nacelle, and around the stabilizer of a business jet airplane. (With 30% choke plug added.)

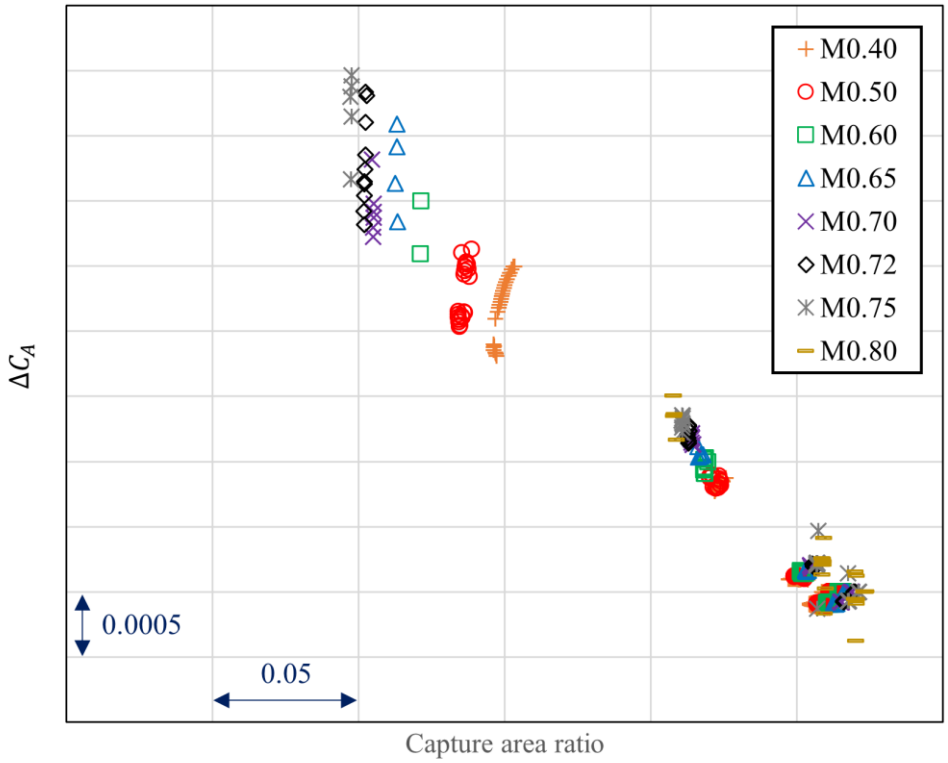

Fig. 2: Nacelle axial force coefficient difference to CAR.

Publications

- Non peer-reviewed papers

Yamada, K., Yamamoto, T., Hamada, C., Ueno, Y., and Ueno, M., Numerical Study on Variation in Spillage Drag by Adding Annular Plug into Flow-Through Nacelle, 60th Aircraft Symposium, 2022.

Usage of JSS

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	N/A
Number of Processes	25
Elapsed Time per Case	12.5 Hour(s)

JSS3 Resources Used

Fraction of Usage in Total Resources[*1](%): 2.35

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	63,854,699.13	2.79
TOKI-ST	47,783.58	0.05
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	520.85	0.03
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	665.54	0.60
/data and /data2	124,039.76	0.96
/ssd	380.03	0.05

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[*2] (%)
J-SPACE	41.26	0.18

[*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)	298.63	0.21

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