Basic research for system integration of silent supersonic airplane

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Abstract

The system integration design technologies for achieving low sonic-boom, low aerodynamic drag, low landing and take-off noise, and light weight simultaneously are the key technologies for future supersonic airplanes. JAXA is promoting the R&D for these technologies based on our experiences of demonstrating the advanced low-drag and low-boom design concepts.

Ref. URL: http://www.aero.jaxa.jp/eng/research/frontier/sst/

Reasons and benefits of using JAXA Supercomputer System

To achieve low sonic-boom, low aerodynamic drag, low landing and take-off noise, and light weight simultaneously, the multi-objective optimization tools are utilized in the design study. A supercomputer is necessary to efficiently evaluate these multiple evaluations.

Achievements of the Year

Trim improvement by canards has been considered in the design of low-boom supersonic aircraft. However, the shock wave from the canard itself degrades the its low-boom performance. In this study, effective canard geometry for both low boom performance and trim performance were investigated by examining the canard area required for trimmed flight and its low-boom performance. The canard area was determined and the near-field pressure signature was estimated by CFD calculation by using FaSTAR (Fig. 1), and the near-field pressure signatre was modified by Multipole Analysis by using MPnoise. Then, acoustic propagation analysis by using Xnoisewas performed on the modified near-field pressure signature to estimate the sonic boom on the ground. As a result, it was confirmed that the ground pressure signature was improved by the canard geometry and appropriate low-boom fuselage design that cancels the shock wave (Figure 2), thus reducing sonic boom strength compared to the original geometry. The trade-off relationship between canard area and low-boom performance due to canard geometry was also clarified.

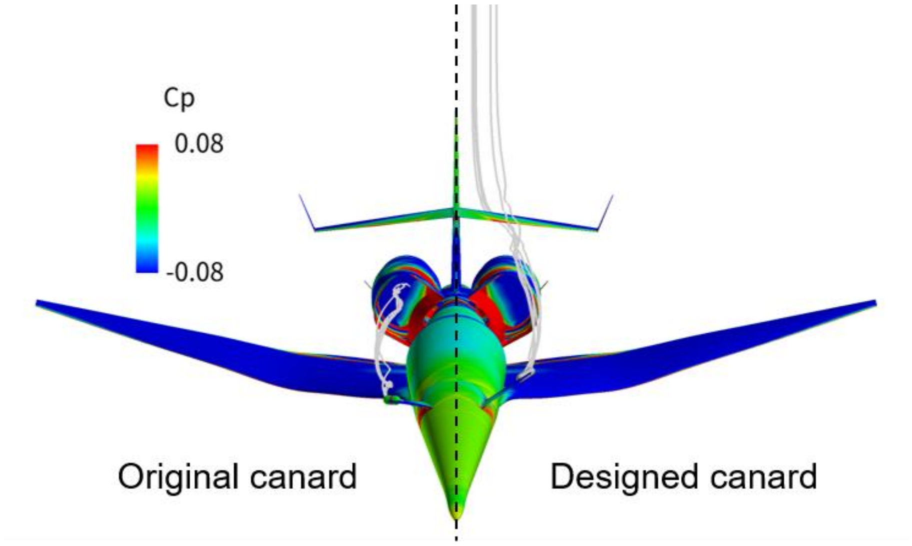

Fig. 1: CFD calculationfor both original and designed canard

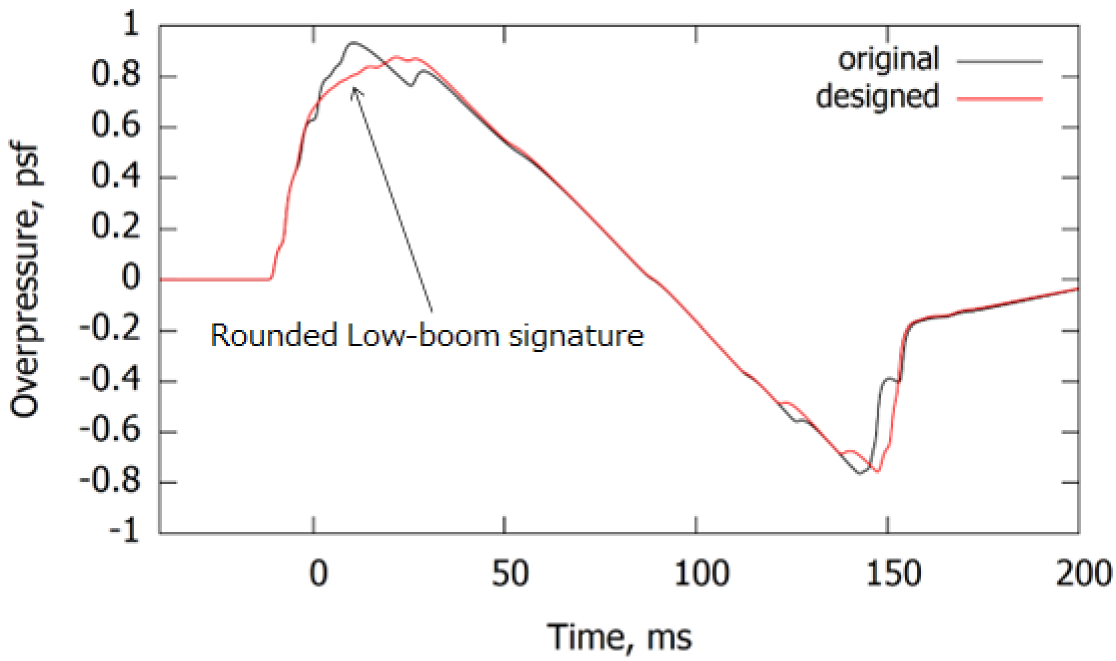

Fig. 2: Improvement of ground pressure signature by canard and low-boom fuselage design

Publications

N/A

Usage of JSS

- **Computational Information**

Process Parallelization Methods	MPI
Thread Parallelization Methods	Automatic Parallelization
Number of Processes	384 - 1024
Elapsed Time per Case	13 Hour(s)

- **JSS3 Resources Used**

Fraction of Usage in Total Resources*1(%): 0.26

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage*2(%)
TOKI-SORA	6,190,385.72	0.27
TOKI-ST	143,264.77	0.14
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	2,078.47	0.14
TOKI-TST	1.06	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	1,006.67	0.91
/data and /data2	68,956.67	0.53
/ssd	10,306.67	1.43

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[*2] (%)
J-SPACE	0.65	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)	3,041.83	2.12

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