Basic research for system integration of silent supersonic airplane technologies

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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 for using JSS2

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. The super computer is necessary to obtain the multiple objective function efficiently with many numerical simulations.

Achievements of the Year

Numerical analyses on exhaust nozzle shapes and jets for aft-boom shaping was conducted. The NASA nozzle 6 configuration was used as the baseline and effects of its inner profile, outer profile and nozzle pressure ratio on the near field signature were investigated. It was found that the nozzle outer profile and the nozzle pressure ratio are more sensitive to the near field signature than the nozzle inner profile. In addition, numerical simulations on intake-buzz and an design study to seek an unconventional aircraft configuration to achieve higher sonic-boom mitigation were performed using JSS2.

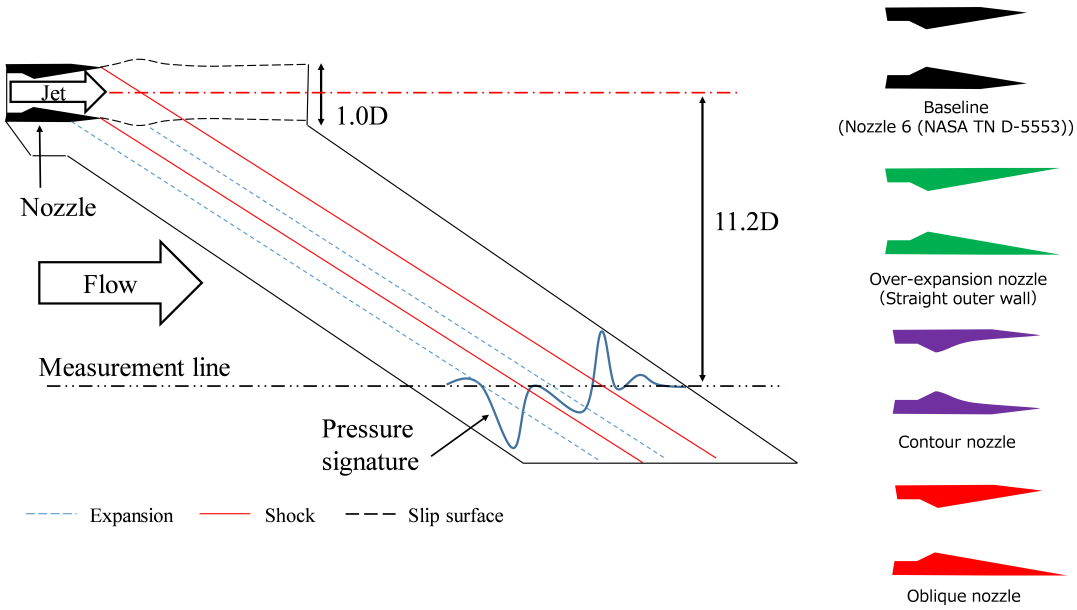

Fig. 1: Schematic of numerical analysis and nozzle shapes

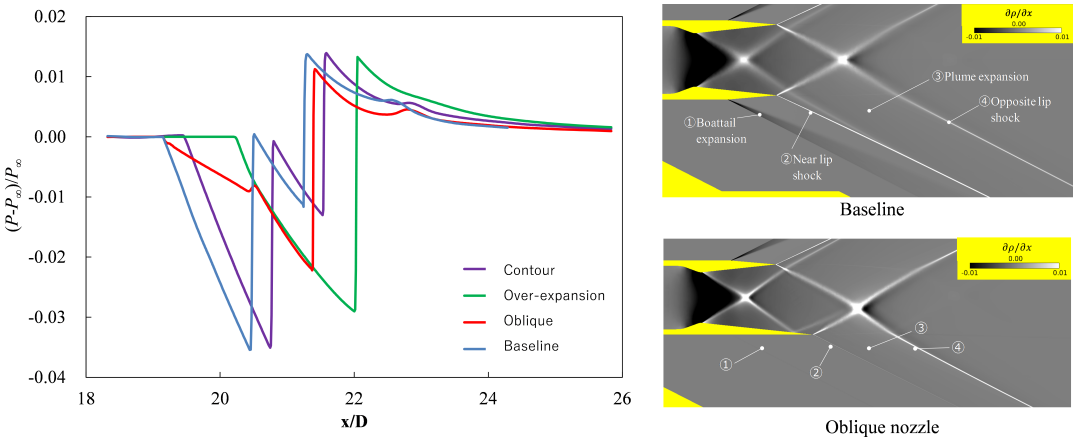

Fig. 2: Examples of near field signatures and flow fields

Publications

- Oral Presentations

1) Obata, H., Akatsuka, J., Ueno, A., and Watanabe, Y., Numerical Investigation on Nozzle Exit Shape and Plume for Aft-Boom Mitigation of Supersonic Transport, Proceedings of The 59th Conference on Aerospace Propulsion and Power (in Japanese)

2) Yoshida, H., Sato, Y., Murakami, K., Makino, Y., Ueno, A., Nakakita, K., Numerical Study using Detached Edy Simulation (DES) of Supersonic Inlet Buzz for the Silent Supersonic Transport, Proceedings of the 56th Aircraft Symposium (in Japanese)

3) Kishi, Y., Makino, Y., Kanazaki, M., Aerodynamic Design of Low-boom SST by Forward-swept Wing Consepti, Proceedings of the 56th Aircraft Symposium (in Japanese)

Usage of JSS2

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	Automatic Parallelization
Number of Processes	30 - 120
Elapsed Time per Case	5 Hour (s)

Resources Used

Fraction of Usage in Total Resources[*1] (%): 1.16

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage[*2] (%)
SORA-MA	9,439,538.43	1.16
SORA-PP	112,434.37	0.90
SORA-LM	6,185.91	2.88
SORA-TPP	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage*2 (%)
/home	3,460.72	3.58
/data	105,100.96	1.85
/ltmp	21,809.91	1.87

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2 (%)
J-SPACE	1.78	0.06

[*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.