Environment Conscious Aircraft Systems Research in Eco-wing Technology:Airframe-Engine Noise Reduction Technology

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Abstract

Innovative drag reduction technologies are investigated to reduce the fuel consumption for a conventional aircraft configuration. Aircraft noise prediction technologies and the conceptual design technologies are also developed for future aircraft which achieve low noise and high efficiency.

http://www.aero.jaxa.jp/eng/research/ecat/ecowing/

Reasons for using of JSS2

The JSS2 is used to develop the airframe, engine, and interference noise prediction tools that have high or middle fidelities for applicable to MDO design with high fidelity CFD and FEM analysis. The airframe-engine installation and/or shielding effects are one of important key issues for the future aircraft. The accuracy of current low fidelity analysis for the airframe, engine, and interference noise prediction is not good enough for application to MDO design with high fidelity CFD and FEM analysis toward the future low-noise aircrafts. The JSS2 is required for development of high or middle fidelity noise prediction tools for competitiveness in technology.

Achievements of the Year

The accuracy and efficiency of airframe noise prediction (CFD/CAA) tools were improved by increasing the resolution of sound sources on the complex geomeries. And its effect was evaluated by analysis on benchmarking problems proposed in AIAA Workshop on Benchmark Problems for Airframe Noise Computations (BANC).

The performance of a JAXA's CFD/CAA solver, UPACS was improved for JSS2 by installing an improved treatment between each grid block developed in 2016 and a low-dissipation scheme to achieve higher fidelity and speed-up on the complex geometries . Fig.1,2 show the flow features by CFD and CAA analisys on a tandem cylinder and a leading edge slat which are the benchmarking problems. Small scaled vorties were clearly observed on the shear layer region and separation area. The resolution for sound sources was increased by combination of improved higher-order scheme using a low-dissipation upwind SLAU scheme and a central difference scheme developed in 2017. Furthermore, the convergence of the numerical analysis was also enhanced as well as higher flow resolutions. Improvement of the accuracy and efficiency on on the complex geometries were achieved on JAXA's CFD/CAA tools.

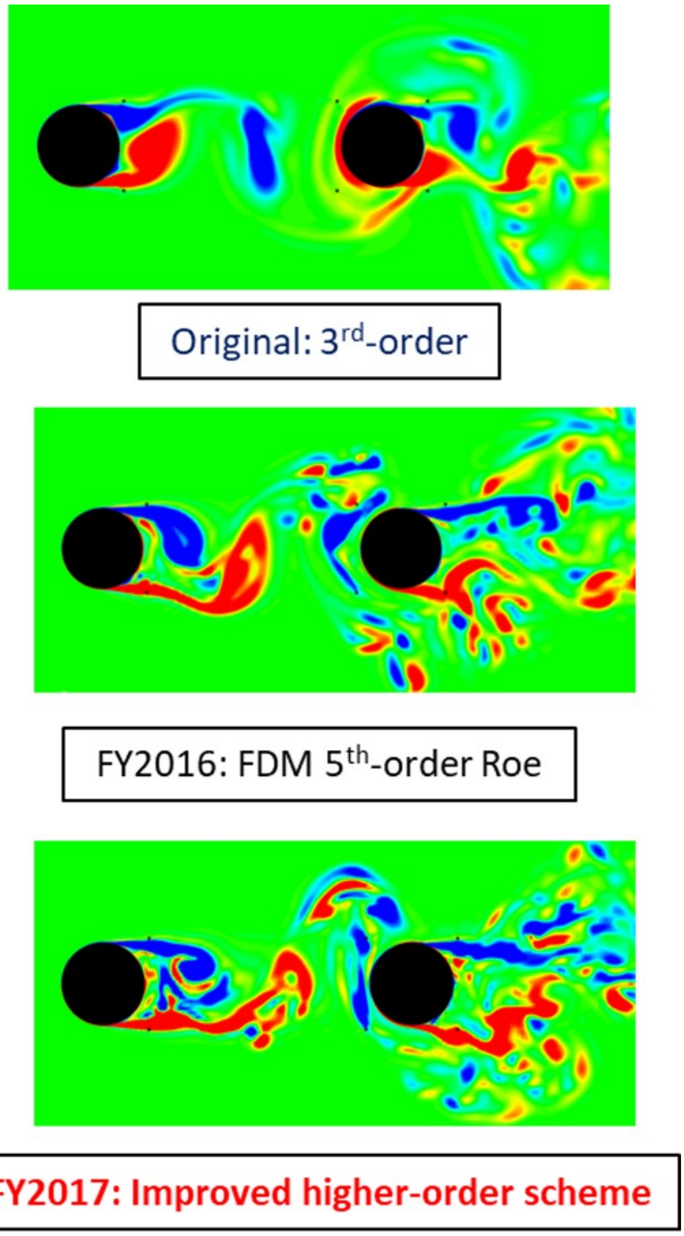
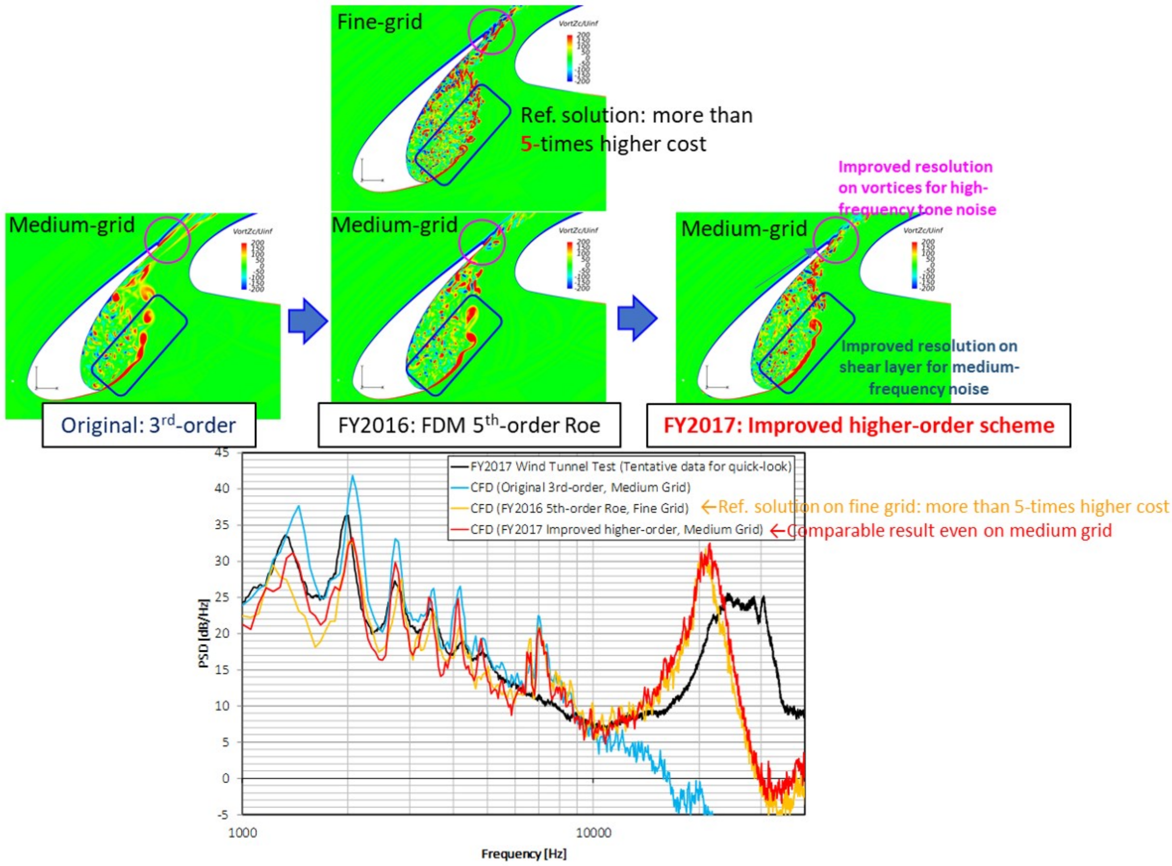


Fig.1 Simplified benchmark problem for landing-gear noise prediction



Comparison with CFD and WTT

Fig.2 Benchmark problem for slat noise prediction
(JAXA/NASA Collaboration Research: 30P30N wind tunnel test)

Publications

- Non peer-reviewed papers

1) Tomoaki Ikeda, et.al., "Aerodynamic Noise Simulations Resolved by Higher-order Spatial Schemes on JAXA's UPACS", 14th International Conference on Flow Dynamics, 2017.11.

Usage of JSS2

- **Computational Information**

Parallelization Methods	MPI
Thread Parallelization Methods	OpenMP
Number of Processes	20 - 800
Elapsed Time per Case	349.00 hours

- **Resources Used**

Fraction of Usage in Total Resources*1 (%): 1.30

Details

Computing Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage*2 (%)
SORA-MA	10,627,256.06	1.41
SORA-PP	2,057.55	0.03
SORA-LM	0.00	0.00
SORA-TPP	0.00	0.00

File System Resources		
File System Name	Storage assigned(GiB)	Fraction of Usage*2 (%)
/home	497.16	0.34
/data	20,313.45	0.38
/ltmp	9,073.39	0.68

Archiver Resources		
Archiver System Name	Storage used(TiB)	Fraction of Usage*2 (%)
J-SPACE	95.39	4.10

*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