Innovation for Design, Data-acquisition, Trouble-shoot and Certification in Aircraft Development: Basic Techniques for Real Flight Prediction

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Abstract

The Aerodynamic Prediction Technology, which is a part of the Innovation for Design, Data-acquisition, Trouble-shoot and Certification in Aircraft Development, constructs the assist technologies to accelerate domestic aircraft development sequences using basic aerodynamic technologies. The target of the Aerodynamic Prediction Technology is paradigm shift from artisanal prediction to analytical one to accelerate domestic aircraft development sequences. This research aims to develop a computational fluid dynamics (CFD) method for simulating the effect of aerodynamic devices, such as vortex generators (VGs), to predict the effect of the aerodynamic devices on real aircraft.

Ref. URL: http://www.aero.jaxa.jp/eng/research/basic/application/

Reasons for using JSS2

Computational simulations using the JSS2 reveal detailed physical phenomena of the aerodynamic devices, which is difficult only with wind tunnel tests, and enable to improve the design of the devices.

Achievements of the Year

CFD simulations with the TAS code were conducted for JAXA's high-lift wing noise research model, OTOMO2, with and without vortex generators (VGs). The automatic local remeshing method of an unstructured grid generator, MEGG3D, enabled us to conduct an efficient parametric study of VG locations on the flap. Vortices from VGs placed on the flap interact with the boundary layer on it, suppress boundary layer separation, and improve the flap performance (Fig. 1).

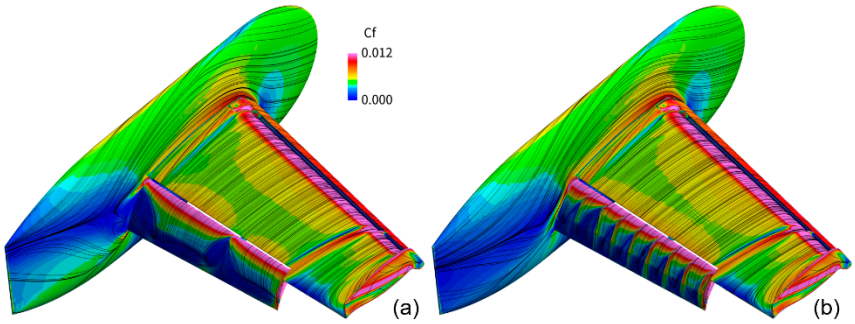

Fig. 1: Skin-friction distributions and surface streamlines: (a) baseline configuration; (b) Configuration with eight VGs placed at 15% chord locations

Publications

- Peer-reviewed papers

1) Namura, N., Shimoyama, K., Obayashi, S., Ito, Y., Koike, S., and Nakakita, K., "Multipoint Design Optimization of Vortex Generators on Transonic Swept Wings," Journal of Aircraft, accepted for publication.

- Non peer-reviewed papers

1) Koike, S., Ito, Y., Murayama, M., Nakakita, K., Yamamoto, K., and Kusunose, K., "Experimental Investigation of Vertical Stabilizer with Vortex Generators and Dorsal Fin," AIAA Paper 2018-3180, 2018 Applied Aerodynamics Conference, Atlanta, GA, June 2018, DOI:10.2514/6.2018-3180.

2) Ito, Y., Murayama, M., Koike, S., Yamamoto, K., Nakakita, K., and Kusunose, K., "Computational Investigation of Vertical Stabilizer with Vortex Generators and Dorsal Fin," AIAA Paper 2018-3530, 2018 Flow Control Conference, Atlanta, GA, June 2018, DOI:10.2514/6.2018-3530.

Usage of JSS2

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	OpenMP
Number of Processes	216 - 324
Elapsed Time per Case	24 Hour (s)

Resources Used

Fraction of Usage in Total Resources[*1] (%): 1.21

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage*2 (%)
SORA-MA	11,273,945.20	1.38
SORA-PP	4,505.17	0.04
SORA-LM	608.93	0.28
SORA-TPP	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage*2 (%)
/home	60.94	0.06
/data	6,966.01	0.12
/ltmp	4,956.71	0.42

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2 (%)
J-SPACE	4.41	0.15

*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.