Boundary Layer Flow Control Technologies

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Abstract

Vortex generators (VGs) are often applied to an aircraft to resolve issues that require performance improvement during a flight test phase, and their size and installation locations are often determined by trial and error in flight tests. The objective of this research is to improve the current VG layout and design technology, so that it can be incorporated into aerodynamic design that actively utilizes VGs from a conceptual design phase.

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

Reasons and benefits of using JAXA Supercomputer System

Computational simulations using the JSS reveal detailed physical phenomena of VGs, which are not able to be obtained only with wind tunnel tests, and enable to improve the design of VGs.

Achievements of the Year

To investigate Reynolds-averaged Navier-Stokes technologies required to predict the effect of VGs installed on a trailing-edge flap of a high-lift wing for the suppression of boundary layer separation, a two-dimensional infinite wing was chosen until last fiscal year because high-resolution meshes were able to be used. Mesh generation guidelines elaborated through this research for predicting the effect of VGs have been applied to the JAXA high-lift research wind tunnel model, OTOMO2, as a representative of a three-dimensional model. It was confirmed that the mesh generation guidelines were also useful for the OTOMO2 both in wind tunnel conditions and assumed flight conditions (Figure 1).

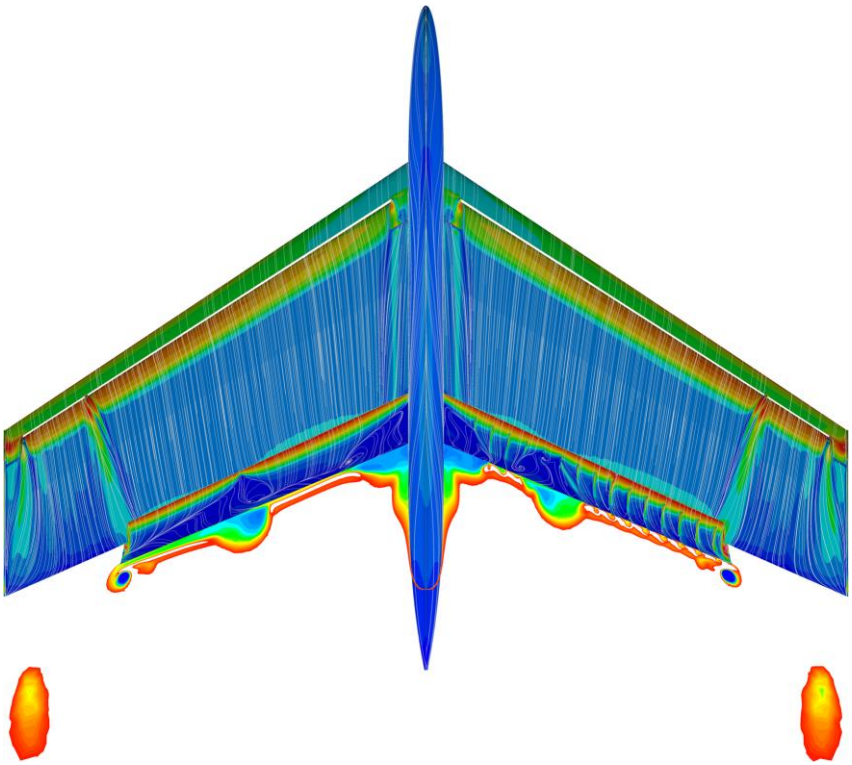

Fig. 1: Differences of surface streamlines, surface skin friction distributions and total pressure distributions on a cross-section through the flap with (right) and without (left) VGs on the flap in a flight condition

- **Publications**

  N/A

- **Usage of JSS**

- **Computational Information**

Process Parallelization Methods	MPI
Thread Parallelization Methods	Automatic Parallelization
Number of Processes	324
Elapsed Time per Case	180 Hour(s)

- **JSS3 Resources Used**

Fraction of Usage in Total Resources[*1](%): 1.91

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	51,316,559.27	2.24
TOKI-ST	8,919.87	0.01
TOKI-GP	0.00	0.00
TOKI-XM	13,250.77	8.29
TOKI-LM	2,240.31	0.15
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	94.85	0.09
/data and /data2	15,375.93	0.12
/ssd	1,214.08	0.17

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[*2] (%)
J-SPACE	47.14	0.21

[*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)	128.96	0.09

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