

## Numerical Analysis of Low-Speed Buffet using High-Resolution Scheme

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### ● Abstract

Post Limiter has been improved to "Post Limiter 3(new)", and incorporated into JAXA's flow analysis code "FaSTAR." Then, its performance has been demonstrated in several aerodynamic problems.

"Post Limiter 3(new)" and "HR-SLAU2" (numerical flux) are combined as a high-resolution scheme, for flow analysis of low-speed buffet around NASA-CRM aircraft. This combination successfully reproduced experimental data.

### ● Reasons for using of JSS2

Expensive computations are carried out.

In addition, one of our objectives was to confirm that the high-resolution "FaSTAR" (the present FaSTAR) successfully ran on JSS2.

### ● Achievements of the Year

"Post Limiter 3 (new)" (Post Limiter 3 applied not only to primitive variables, but turbulent viscosity) has been incorporated into "FaSTAR" (JAXA's flow analysis code), and its performance has been demonstrated in several aerodynamic problems. Then, high resolution schemes "Post Limiter 3 (new)" and "HR-SLAU2" (numerical flux) are employed to resolve complex flow physics of low-speed buffet around aircraft (Fig.1). This combination successfully reproduced experimental data (Fig.2). These results have been published in Journal of Computational Physics and reported in conferences.

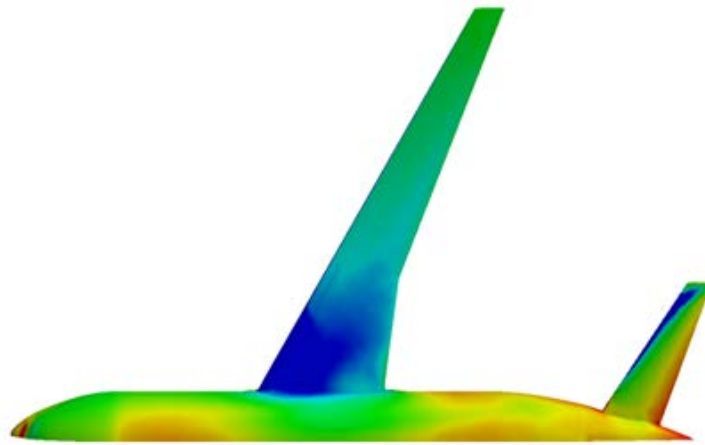


Fig.1 Upper Surface Pressure Distribution on Aircraft (HR-SLAU2 + Post Limiter 3 (new))

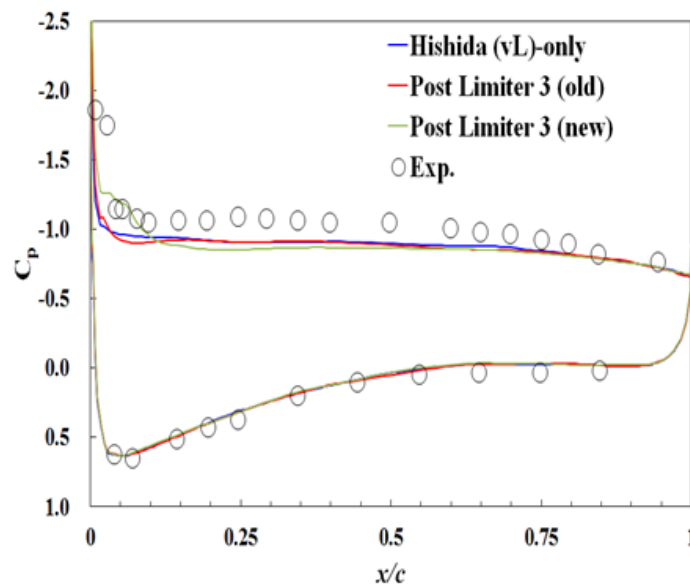


Fig.2 Pressure Distributions at 28.3% Spanwise Cross-Section

## ● Publications

### ● Peer-reviewed papers

- 1) Kitamura, K. and Hashimoto, A. "Simple a posteriori slope limiter (Post Limiter) for high resolution and efficient flow computations," *Journal of Computational Physics*, Vol.341, 2017, pp. 313-340. doi:10.1016/j.jcp.2017.04.002.
- 2) Kitamura, K., Ogawa, S., and Takahama, T. "Aerodynamic Improvements of Airfoils at Low Reynolds Number by Moving Surface Method," *JSASS Aerospace Technology Japan* (in Japanese) (Accepted)
- 3) Kitamura, K., Aogaki, T., Inatomi, A., Fukumoto, K., Takahama, T., Hashimoto, A. "Post Limiters and Simple Dirty-Cell Detection for Three-Dimensional, Unstructured, (Unlimited) Aerodynamic Simulations," *AIAA Journal*, (Under 2nd Review)

- Presentations

- 1) Takabayashi, K., Fukumoto, K., and Kitamura, K.: Computational Study on Rigid Disk-Gap-Band Supersonic Parachute Aerodynamics, 31st International Symposium on Shock Waves (ISSW31), Nagoya, Japan, Jul. 9-14, 2017.
- 2) Kitamura, K., Aogaki, T., Hashimoto, A. "Extension of Post Limiter to 3D Unstructured Grids and Its Incorporation into FaSTAR," ANSS2017, 2017, Tokyo.
- 3) Kitamura, K., Aogaki, T., Inatomi, A., Fukumoto, K., Takahama, T., Hashimoto, A. "Post Limiters and Simple Dirty-Cell Detection for 3D, Unstructured, (Unlimited) Aerodynamic Simulations," AIAA Aviation 2018 (to be presented in Atlanta, USA)

- Usage of JSS2

- Computational Information

|                                |             |
|--------------------------------|-------------|
| Parallelization Methods        | MPI         |
| Thread Parallelization Methods | N/A         |
| Number of Processes            | 4 - 1024    |
| Elapsed Time per Case          | 50.00 hours |

- Resources Used

Fraction of Usage in Total Resources\*1 (%): 0.99

Details

| Computing Resources |                                    |                         |
|---------------------|------------------------------------|-------------------------|
| System Name         | Amount of Core Time (core x hours) | Fraction of Usage*2 (%) |
| SORA-MA             | 8,188,884.46                       | 1.08                    |
| SORA-PP             | 7,011.75                           | 0.09                    |
| SORA-LM             | 7,358.28                           | 3.79                    |
| SORA-TPP            | 0.00                               | 0.00                    |

| File System Resources |                       |                         |
|-----------------------|-----------------------|-------------------------|
| File System Name      | Storage assigned(GiB) | Fraction of Usage*2 (%) |
| /home                 | 064.90                | 0.04                    |
| /data                 | 1,227.38              | 0.02                    |
| /ltmp                 | 13,281.26             | 1.00                    |

| Archiver Resources   |                   |                         |
|----------------------|-------------------|-------------------------|
| Archiver System Name | Storage used(TiB) | Fraction of Usage*2 (%) |
| J-SPACE              | 8.89              | 0.38                    |

\*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