Development of a Many-block Method for Enabling an Extremely Fast Combustion LES

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Abstract

In this research, by the following two approaches: (1) acceleration of time integration by implicit time integration method and (2) acceleration of calculation using an accelerator, we try to achieve a speedup of more than 100 times compared with the current level of CFD runs. We aim to develop a “many-block method” that can complete a single case of turbulent combustion LES in an extremely short time period.

Reasons for using JSS2

We used JSS2 for developing a LES code by a “many-block method” that has inner cells for high-order interpolation inside an unstructured cell, and for performing LES analysis with 100 million grid points.

Achievements of the Year

In this research, we developed a LES code by “many-block method” that has inner cells for high-order interpolation inside an unstructured cell. We performed an LES analysis for a cylinder at Re = 3900 with about 63 million unstrectured hexa-cells (Figs. 1 and 2).

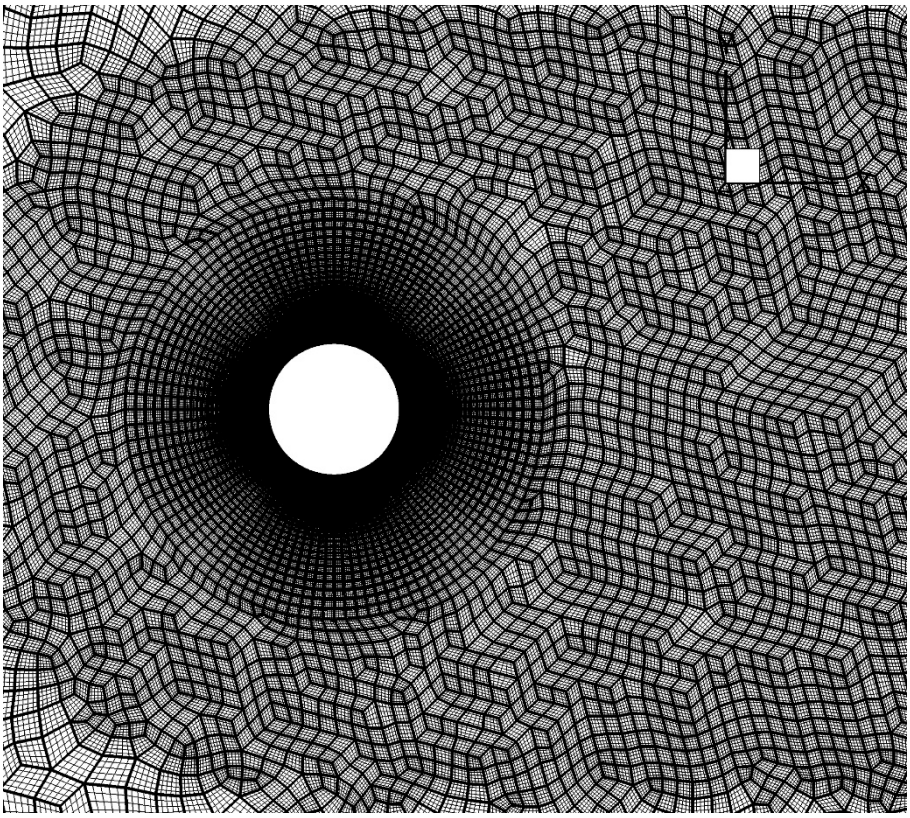

Fig. 1: Example of unstructured hexa-cells around a cylinder. A single hexa-cell has 5x5x5 subcells in its inside. Cited from non peer-reviewed paper [2].

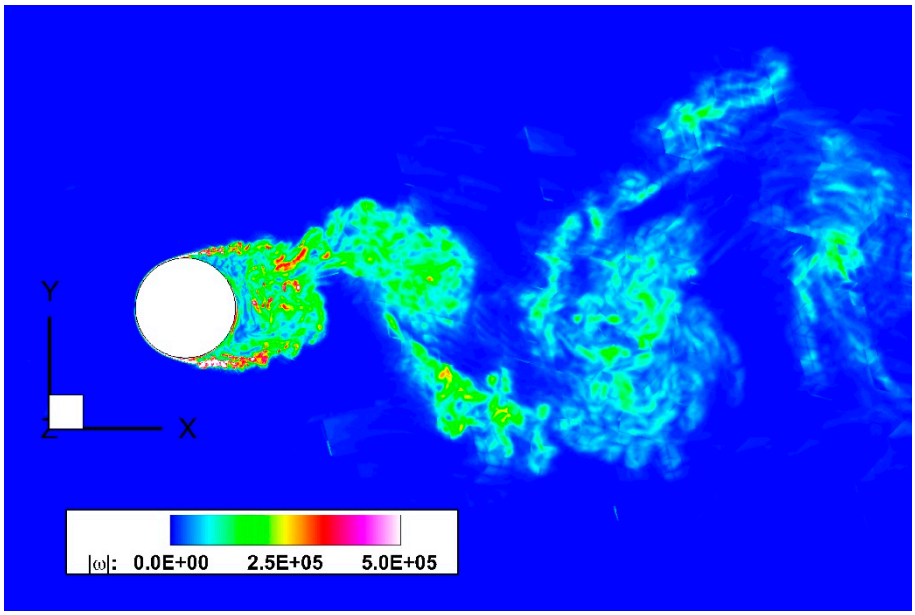

Fig. 2: Instantaneous contours of vorticity magnitude on the x-y plane for the LES around a cylinder at Re = 3900. Cited from non peer-reviewed paper [2].

Publications

- Non peer-reviewed papers

1) Shingo Matsuyama, “High-order Unstructured-grid Large Eddy Simulation Using Many-block Method”,

Proceedings of the 50th Fluid Dynamics Conference / the 36th Aerospace Numerical Simulation Symposium, 3E02, 2018.

2) Shingo Matsuyama, “Unstructured-grid LES Using Many-block Method”, Proceedings of the 32nd CFD Sympoium, C08-3, 2018.

- Oral Presentations

1) Shingo Matsuyama, “High-order Unstructured-grid Large Eddy Simulation Using Many-block Method”, the 50th Fluid Dynamics Conference / the 36th Aerospace Numerical Simulation Symposium, 2018.

2) Shingo Matsuyama, “Unstructured-grid LES Using Many-block Method”, the 32nd CFD Sympoium, 2018.

Usage of JSS2

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	OpenMP
Number of Processes	64 - 256
Elapsed Time per Case	48 Hour (s)

Resources Used

Fraction of Usage in Total Resources[*1] (%): 0.00

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage[*2] (%)
SORA-MA	5,106.17	0.00
SORA-PP	0.00	0.00
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	399.29	0.41
/data	1,899.35	0.03
/ltmp	325.52	0.03

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2 (%)
J-SPACE	0.00	0.00

*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.