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Parallel Unstructured Grid Generation Method Based on the Block-Structured Cartesian Grid Approach Aimed for Large-Scale Computations.

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Computational Fluid Dynamics has achieved a significant progress in its algorithms and applications in the last 40 years and become a necessary tool for developing fluid machines and understanding fluid mechanics. Among various approaches, a computational method using unstructured grids is becoming popular in the CFD community in its advantage in treating 3D realistic geometry over the conventional approach using structured grid and Cartesian grid [1,2].

However, there are several issues about the unstructured grid CFD. Most critical one is the grid generation. Unstructured grid method always needs a “water-tight” geometry to start grid generation including surface and volume grid. The grid generation process can still be very time consuming if “non-water-tight” geometries are given because CFD users have to repair or clean a “dirty” geometry with cracks or overlaps before grid generation. This is a bottleneck of CFD use.

These days, hexahedral grid generation based on Cartesian grid approach is being focused [3-5]. This approach has advantage in treating dirty geometry compared to conventional grid generation approach. In this paper, we present an efficient hexahedral grid generation method aimed for large-scale computations to use the framework of the Building-Cube Method for easy parallelization.

Building-Cube Method is a block structured Cartesian grid approach proposed by Nakahashi [6]. In this approach, flow field is divided into several size of “Cube” and each cube has uniform spacing Cartesian grid named “Cell” as shown in Fig. 1. The geometrical size of each cube is determined by adapting to the geometry and the flow features like an adaptive refinement Cartesian grid. One of the attractive point of BCM is easy parallelization both grid generation and flow solver.

The hexahedral grid generation procedure used in this research is as follows;

- Cartesian grid generation base on the Building-Cube Method,
- Surface grid construction,
- Volume grid construction,
- Prismatic layer generation around geometries,
- Feature recovery.

The examples of the unstructured grid around an airfoil by the present approach are shown in Fig. 2. Grid generation procedures are parallelized by cube-unit. The detail and the efficiency of the present approach will be shown in the final paper.

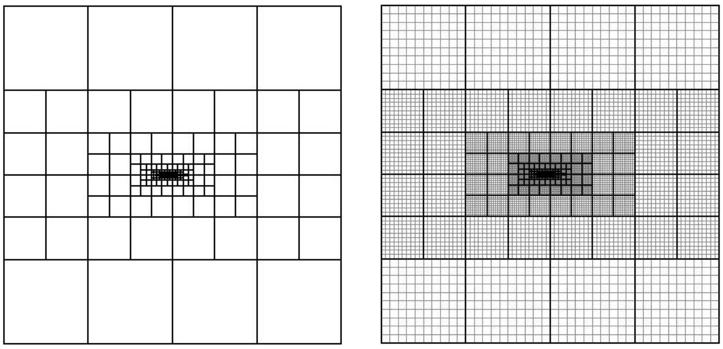

Fig. 1. Cube(left) and Cell(right).

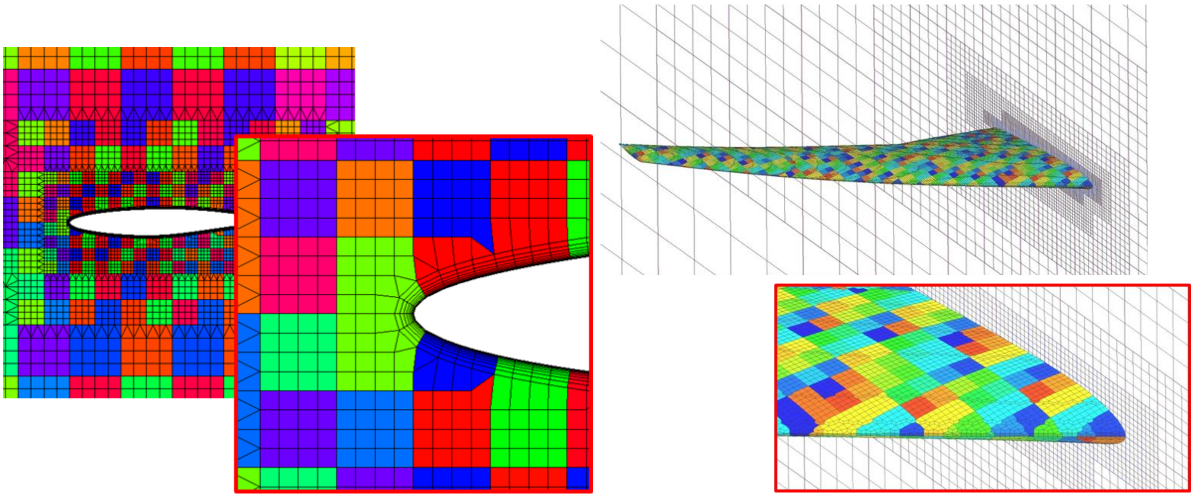

Fig. 2. Unstructured grid around an airfoil. (left:2D case, right 3D case)

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